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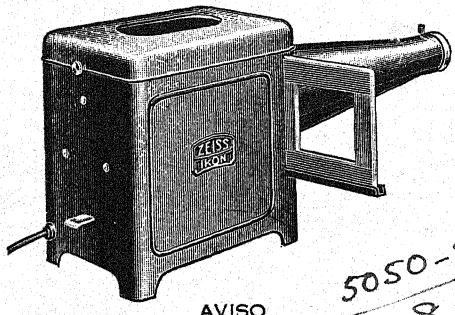

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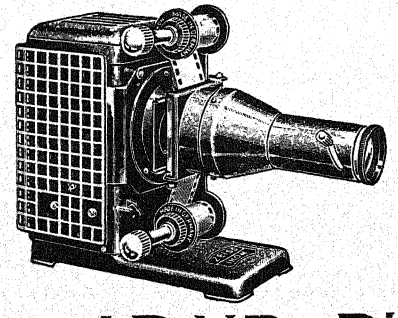

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Science and Society

IMMEDIATELY after the formation of a "New Division" by the British Association for the Advancement of Science, whose ostensible object is to institute enquiries into the social relations of science, events on a stupendous scale occurred in central Europe whose impact on international affairs was such as to rock the whole fabric of civilization to its very foundation. The ardent supporters of the "New Division" maintained a solid silence which must have earned for science the obligation of politicians for not embarrassing their delicate and difficult negotiations. Manifestly the function of creating public opinion either in favour of or in opposition to the conduct of diplomatic relations has become the prerogative of the lay press and of the members of the parliamentary opposition. From the general attitude of the whole body of scientists during the recent crisis, it is to be inferred that they make a sharp distinction between social affairs and political problems and that, while the former might constitute a legitimate sphere for their interventions, the latter had best be avoided. We doubt the existence of such a sharp demarcation between the social and political questions whose paths cross one another and in certain directions become interwoven, and it must be dreadfully pretentious to keep them isolated. We can hardly conceive of any political topic the material of which does not prejudice social interpretation, and what is most obvious is that social progress depends in a large measure upon the political acts and policies of statesmen, while both are sustained by the inventions and discoveries of science. Our inability to determine the future trends of human affairs is mostly due to our lack of faith that the progress of social science must be a solvent of most of the economic maladjustments and because we do not maintain the courage and spirit of adventure, so successfully employed in the realms of science, in the political and administrative fields, we are confronted with widespread social and political disappointments.

We welcome the establishment of a "New Division" as an indication on the part of British scientists of their earnestness to investigate the social institutions and the acts and policies of governments which affect the social conditions of national life. In a leading article published sometime ago,

the editor of *Nature*[1] envisages the evolution of a new type of society in which reason and conviction by an appeal to reason are the indispensable bases for any ordered, successful and permanent social advance. The influence of scientists on the destiny of the world may be friendly and fertilising or may be hostile and destructive according to the use to which their discoveries and inventions are applied. The ultimate question on which the fate of the future trend of civilization will depend is the responsibility which scientists are prepared to accept in controlling and directing their gifts and to disentangle the economic maladjustments which give rise to grave disturbances in the domestic and international relationships. Society has willingly permitted those technical improvements which have promoted its material prosperity without previous planning and without provision against maladjustments and naturally disturbances arising from lack of control and direction, must fall heavily on those classes which are economically backward. Scientists accept the laws of cause and effect in their fields of enquiry and partly because of certain social complexes and partly because of their general unwillingness, they hesitate to apply their objective mode of investigation to the organisation of society. This hesitancy on the part of intellectuals must account in a large measure for their thinking irrationally when they have to deal with society as a whole. The lay mind is puzzled over the gaps existing between the technical advance and the social system, the unequal distribution of economic burden and distress in the midst of abundance. Some of the paradoxes of modern life may be removed by exploring the sociological laws of cause and effect on lines similar to the natural science.

The field for such enquiry is practically unlimited in India, and the need for formation of a department of scientific investigation is necessary and urgent. The social organisation of India has a religious background and the possibility therefore, of influencing its conduct is limited by traditional authorities, which happily are breaking down. The constructive outlook for remodelling the social relations of a population differing in almost every detail of its tissue, has long remained beyond the grasp of public leaders and it never formed an integral part of the programme of national progress. The opportunity for scientists in India for supplying this dreadful deficiency in national planning is mature and attractively inviting. The social forces due to an immobile population with an upward tendency, prevention of its migration, unemployment, poverty and illiteracy are as disruptive in India as in any other part of the empire. The task of converting these forces into constructive channels must involve a deeper insight into human nature, which has to be studied both from the philosophical and scientific standpoints; and especially when life seems to be under a heavy travail, a sympathetic concept of its impulses, thoughts and reactions should be an invaluable guide for recognising its social, economic and political trends. We doubt whether after all even scientists and psychologists have discovered the technique or the weapon which they would willingly place in the hands of legislators for reorganising the state and its people.

It seems to us that the Indian Science Congress which enjoys a high prestige in the country should convene a conference of scientists in India for inaugurating a department with the ostensible object of exploring the possibilities of extending scientific methods to the study of social problems. Science has too long been divorced from society, because of the idea that the province of science is matter, and the human sciences like biology, sociology and economics had not acquired the status and importance of the physical sciences. The consequence has led to a dreadful state of affairs where the physical and the moral are indistinguishably mixed up in the social conditions. It becomes increasingly clear how hopeless it is to disentangle them and

[1] *Nature*, April 30, 1938, **141**, No. 3574.

establish new trends in society whose development has been permitted to grow ever more confused and chaotic. The new age of liberalism which has emerged from that of traditionalism must obviously create dynamic changes in the whole social framework, but the impulse of expansion is restricted to special groups which discovered the inadequacy of the traditional mode of moulding character and mind. The changes have now overtaken the masses without being prepared to profit by their results. This unbalance in the social structure must account for all its ills. Have the scientists any technique or formula for their solution? While the social legislator should possess a clear and far-sighted vision of the kind of society he would bring into being, the social scientist should have knowledge to control and direct its tendencies. Science ought to be able to offer answers to questions which governments might ask for their solution and unless a symbiotic relationship is established between social sciences and statecraft, society must drift perhaps on a down-hill course. The infusion of a scientific temper into governance might remove the fanaticism and arrogance of injudicious zealots, "transforming the blaze of passionate propaganda into a cool grotto where people would humbly investigate economic facts and social conditions—which would render the politician sufficiently uncertain about his own conclusions to respect the honest convictions of those with whom he differs".

If the scientific men in India should realise their responsibilities in the task of recognising society, the Indian Science Congress should step across the frontiers of specialists' studies by arranging at its annual sessions symposia on social, economic and ethical problems investigated by the proposed committee. The Congress is most favourably endowed for bringing to bear upon society the broadening and stimulating effects of science, and its realization that the immediate purpose of science is the ordered progress of society, ought to lead to a revision of the Congress programme of functions so as to bring it into intimate touch with the social thoughts and reactions of the body politic.

Water Pollution Research

By Gilbert J. Fowler, D.Sc., F.I.C.

AN important article on this subject appeared in *Current Science* for July 1938, in which it was urged that a Water Pollution Research Board might well be established in India and numerous directions were pointed out in which the activities of such a Board could be exercised. No better example of the characteristic teamwork necessary for the successful carrying through of the kind of investigation which such a Board might be called upon to undertake could be found than in the remarkable Report recently issued by the Water Pollution Research Board of London on the Estuary of the River Mersey. To the academic research worker, who is confined most of his time to the narrow limits of his laboratory and is accustomed to the use of instruments of precision which enable him to exercise fairly complete control over the changes which he is endeavouring to examine, the kind of work involved in an investigation such as is set out in this Report must often be unfamiliar.

The terms of reference to the Research Department were comparatively short and simple, *viz.*, to investigate "the effect of the discharge of crude sewage into the Estuary of the River Mersey on the amount and hardness of the deposit in the Estuary". Sewage from a population of about 1·4 million people is discharged mostly untreated into the Estuary and the possible effect of this discharge on the conservancy of the Estuary has been the cause for many years of controversy among the local interests concerned. The investigation required to obtain a conclusive answer to the terms of reference was, however, of a very varied and far-reaching nature.

The problem was, in fact, to observe the effect of a daily volume of some 1,000 million gallons of fresh water, 30 or 40 million gallons of which are crude sewage, discharged into the Estuary. The conditions of discharge will vary according to the change of tide and are naturally dependent also upon changes in weather conditions

particularly on rainfall. Hundreds, if not thousands, of analyses had to be made from the time when research began in April 1933 to the date of publication of the Report, November 1937. Besides chemical and bio-chemical factors, the physical properties of colloids of different types have to be understood; engineering methods for measuring stream velocities both surface and subsurface were necessary and hydrographic surveys had to be made in order to determine the area and dimensions of the Estuary at different periods. It is clear that no one individual can combine the knowledge necessary to obtain trustworthy results in all these directions and therefore teamwork of the highest order is necessary to correlate all the varied results and draw a true conclusion.

The finding of the Report is that sewage in the concentration in which it is present in the Estuary has no appreciable effect on the composition of the mud and other solid matter deposited in the Estuary. Mud in suspension in the Mersey Estuary and in other relatively unpolluted estuaries which were examined is in the form of flocs or aggregates and not in the form of finely divided particles. In this condition the rate of sedimentation of mud is not affected by sewage in the concentration found in the Mersey Estuary. There is no evidence of any increase during recent years, 1909–35, in the difficulty of dredging in the sea-channels in the Liverpool Bay. A reduction of about 52 million cubic yards between 1906 and 1931 was mainly due not to the deposition of mud but to the deposition of sand in the deeper parts of the Estuary. Finally the definite conclusion is drawn that the crude sewage discharged into the River Mersey has no appreciable effect on the amount and hardness of the deposit in the Estuary.

The staff consisted of a Chief Chemist assisted by four competent members of the same profession, four or five hydrographic surveyors and a Consulting Civil Engineer, besides the permanent officials of the Water Pollution Research Board and the Mersey Docks and Harbour Board. Many data were also supplied by numerous responsible authorities in the Mersey area. In the observations made on a number of estuaries in the various parts of the British Isles valuable advice and assistance were given by the Government authorities concerned.

This Report on the Mersey Estuary will probably rank as one of the most detailed and conclusive of such reports, inviting comparison with the Board's own Report on the Estuary of the River Tees and the monumental enquiry by the Metropolitan Sewerage Commission of New York on the sanitary condition of New York Harbour, embodied in three formidable volumes published respectively in 1910, 1912 and 1914 together with a great mass of subordinate literature.

These earlier Reports laid emphasis on the depletion of dissolved oxygen by the presence of sewage in excessive quantities. In the Mersey Estuary Report the physical characteristics of naturally occurring mud and its reactions with sewage under the conditions present in the Estuary receive detailed attention. These researches will be of great value as models for similar investigations which are likely to be called for, *e.g.*, in the Estuary of the River Irrawadi at Rangoon and the Yangtsze near Shanghai.

In India similar investigations are called for in connection with the disposal of Calcutta sewage and with the general conditions of the rivers of Bengal. Prof. Saha, indeed, chose "The Problem of Indian Rivers" as the subject of his Presidential Address to the National Institute of Sciences of India at the Annual Meeting held during the Silver Jubilee Session of the Indian Science Congress Association. This address formed an introduction to an important symposium on River Physics.

Besides investigations involving such varied issues as are comprised in the Mersey Estuary Report, the Water Pollution Research Board is also concerned with large-scale experimental work, such *e.g.*, as the purification of milk factory effluents. Important laboratory researches are in progress particularly on the physical and bio-chemical phenomena of the activated sludge process, the base exchange process of water softening and the contamination of water by lead.

Should the establishment of a Water Pollution Research Board for India, adumbrated in the July article in *Current Science*, find favour with the Government the problems awaiting its attention are numberless. In India the simplest and most primitive requirements of sanitation have first to be met in contradistinction to England and many European countries where the purity of the rivers in highly populated areas has the first claim to attention. Few Indian cities or towns have, in fact, a complete water

carriage system of sewerage. The provision of an adequate water supply is rightly insisted upon by all modern centres of population. It is however often forgotten that the final disposal of this water after use for domestic or trade purposes necessarily creates further problems, if serious menace to health is not to occur through the creation of swamps or the piling up of filthy sludge deposits in neighbouring streams and *nullahs*. The claims of agriculture for increased fertilizer supply may be met by the proper utilization of the otherwise nuisance producing residues of town or village.

In devising suitable means for dealing economically with these problems a Water Pollution Research Board for India may well play a part in importance equal to or greater than its prototype in England.

It is only fair to add that several Municipal authorities in India have already shown themselves awake to the importance of such preliminary research work. Nagpur some years ago arranged for scientifically controlled large-scale experiments involving considerable expenditure in order to compare the relative efficiencies of several methods of dealing with their sewage. Bombay and Ahmedabad have appointed Specialist Research Chemists and have provided laboratories for preliminary investigations of the disposal of their sewage and trade wastes.

Bhopal, Indore and Mysore have carried out important researches on a large and practical scale in connection with the conversion of "habitation waste" into "compost" suitable for agricultural use. Should a Water Pollution Research Board be established either as a branch of the Imperial Agricultural Research Council or as an independent body, it will have no difficulty in finding ample work to do and its collaboration will be welcomed by all those who are doing their best, often under rather difficult conditions, to deal with the problems with which they are faced.

How to View a Picture

By A. Narasinga Rao

(*Annamalai University, Annamalainagar*)

A GOOD-SIZED picture is hanging in a vertical plane in front of us. It is required to determine the *proper position* (or positions) at which the eye should be placed so that we may have a *correct view* of the objects represented therein.

Before the question can be answered unambiguously, we have to clarify the concepts described in italics, and state the assumptions under which a solution is sought.

We postulate firstly that the Artist has been so much struck by the beauty of a particular scene that he wants others to share exactly the same experience, and that this constitutes the *raison d' etre* of the picture; secondly, that the picture is drawn according to the laws of perspective and that the colour effects are properly rendered —or that it is a photograph. The observer may be said to have a "correct view" of the picture if his visual impression of the relative positions and dimensions of the objects represented in the picture is identical with that experienced by the artist when he looked at the original landscape. Here we are confronted by the fact that visual geometry is essentially a geometry of directions[1] (since all points in the line of sight are visually identical) and that the visual separation of two points (and hence every estimate of size) is to be measured by the angle subtended at the eye[2] by the two points. It follows therefore that:—

> the "proper position" or positions at which the eye should be placed to look at a picture are just those positions relative to the picture at which the angle subtended by any two points in the picture is equal to the angle subtended at the artist's eye by the corresponding points of the original landscape. ....(1.1)

In the case of a photograph (contact print), the proper position of the eye bears to the photo the same relative position as the lens

[1] A more detailed discussion of the essential features of visual geometry will be found in my paper "Through a Railway Window", *Proc. Ind. Acad. Sci.*, 1938, **7**, No. 2, p. 156.

[2] I am not so heartless as to postulate that all my observers are one-eyed! A single picture can, however, give only a one-eye-view of the universe. To take account of binocular vision the considerations of this paper have to be applied to each of the two pictures (slightly different) corresponding to the two eyes.

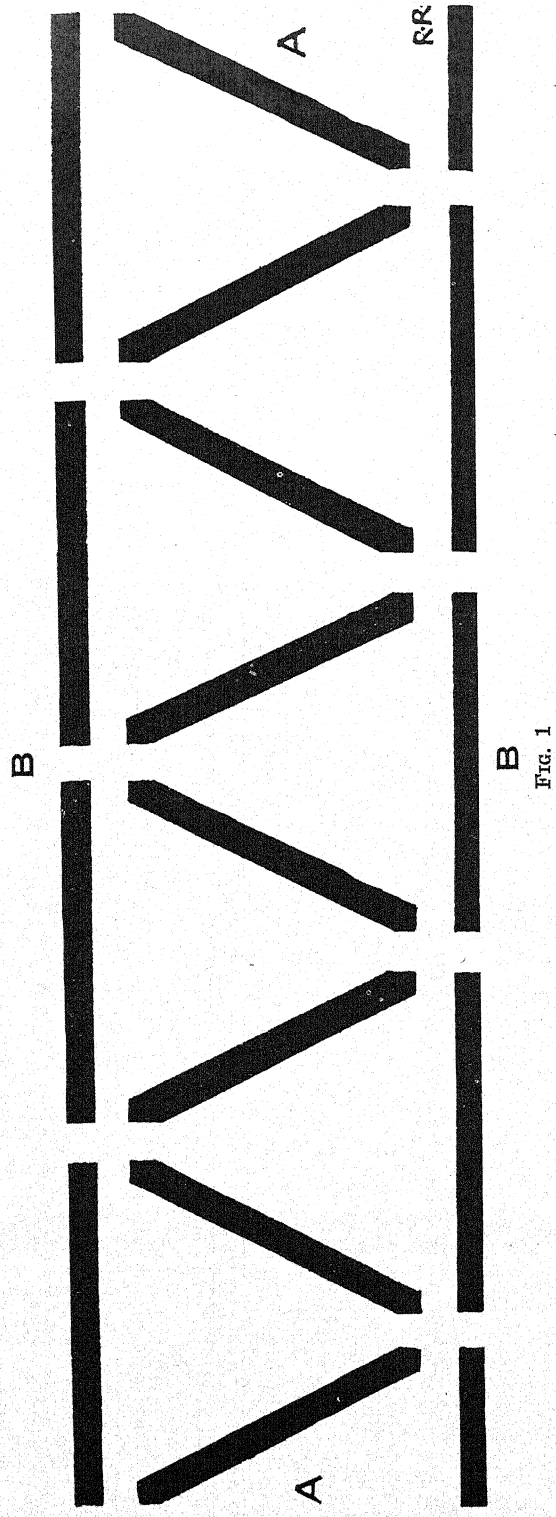

FIG. 1

of the camera to the plate. In the case of a painting, it is the actual position of the eye of the artist relative to the picture; for since it is drawn according to the rules of perspective, the picture may be considered to be the conical projection of the landscape with the eye as vertex of projection.

The questions at issue are:—

(i) Is there only one "proper position"—the one mentioned just now—at which the eye should be placed to get a "correct view"?

(ii) Can such a position be obtained from the data given by the picture itself?

We shall see that the answers to both these questions are in the affirmative.

2. To answer the first query let us assume that there are two possible "proper positions" E_1 and E_2 for the eye of the observer; and let A, B be two points in the picture. By (1.1) the segment AB subtends the same angle at E_1 and E_2, this being the angle subtended at the artist's eye by the two points of the landscape represented by A and B. Hence, if the circle ABE_1 be drawn and rotated about AB, the quartic surface thus generated will pass through E_2. Since this property must hold for every pair of points in the picture, all such surfaces must pass through E_2. It is easily seen, however, that the only common point E_2 is the reflection of E_1 in the plane of the picture. If it is agreed that the observer is to stand in front of the picture and not behind it, there is only one possible position E_1 for the eye which will give a *correct view* of the picture.

Methods for Determining the Proper Position

3. I shall now show that in some cases at least the internal data given by the picture itself will suffice to determine the point E_1, when coupled with our knowledge of what the various patterns represent.

The picture is supposed to be in a vertical plane. The foot of the perpendicular from E_1 on the plane of the picture is called the centre of vision and a horizontal line h drawn through it the "horizon line" corresponding to distant objects at ground level. This line is recognisable in most pictures, but even where it cannot be easily made out, it may be determined if we have in the picture two pairs of lines which are known to represent parallel lines on the ground. Thus suppose we have a quadrilateral pattern ABCD which represents a rectangular object such as a tank, or a tennis court. If the pairs of opposite sides of ABCD meet in P, Q then the horizon line h is PQ. The "proper position" for the eye is in the horizontal plane through h and must be so situated as to project ABCD into a rectangle on any other horizontal plane. Hence the required position lies on the circle described on PQ as diameter. If we have two such patterns which represent rectangles (or one which represents a square) the possible proper positions for the eye of the observer are given as the intersections of two such circles, and will thus be two points E_1 and E_2 which are reflections of each other in the picture plane.

As another example, suppose h has been determined, and also that there is an elliptic pattern Γ in the picture which represents a circular object on the ground or any horizontal plane, such as a circular patch of garden or the mouth of a well. E_1 and E_2 will now be determined as possible vertices which will project h to infinity and Γ into a circle on any horizontal plane. The following construction[3] determines E_1 and E_2:—

Take the pole O of h with respect to the conic Γ and draw two pairs of lines OP, OP′ and OQ, OQ′ through O conjugate relatively to Γ and let them meet h in PP′ and QQ′. Draw two circles on PP′ and QQ′ as diameters in the horizontal plane through h. These will intersect in two points E_1, E_2 which are reflections each of the other in the picture plane. The proper position at which the eye of the observer should be placed is that one which is in front of the picture.

As the main object of this note is to point out the possibility of determining E rather than to give detailed rules for the purpose, I do not elaborate this point further.

A New Optical Paradox

4. Even though the changes in the relative proportions of the parts due to a slight change in the position of the eye often escape attention, it is still of the highest theoretical interest to realise that there is but one position E from which a picture should be viewed so that we may repeat the artist's experience. It is even more startling to find that no other view of the

[3] Filon, *Projective Geometry*, 1935, p. 184.

picture corresponds exactly to the landscape painted by the artist even when the position of the artist is left unspecified; in other words, if the view of the picture from any point F other than E be compared with a painting of the original landscape from every conceivable point of observation—their totality having the same cardinal number as the continuum—not even one of these will agree with the picture.

To prove the last statement, let us assume that the view of the picture from E corresponds exactly to the view of the original scenery from O, and also that the view of the picture from F corresponds to the view of the same scenery from some point P. If A, B, C are three points in the original scenery which are coplanar with O, they are represented in the picture by collinear points *a, b, c*. Now *a, b, c* will appear collinear from any other point of observation F, and hence according to our assumption, A, B, C must be coplanar with P. Thus every plane ABC through O passes also through P. This is obviously impossible if P is different from O.

The reason why the changes discussed above do not readily attract attention is that the mind thinks of a picture in terms of patterns, each of which has a specific significance rather than in terms of the proportions of the various parts. It is not difficult, however, to draw a diagram consisting of disconnected lines in which the patterns are not already drawn and presented ready-made to the eye but are left to be formed by the mind. A change in the proportion of the parts may in this case change the pattern itself so that the picture will be subject to a startling change when the position of observation is altered. I give below such a figure (Fig. 1) which, when placed flat on a table and viewed in the direction AA, presents an appearance similar to the pattern[4] in Fig. 2. However, if the same figure be viewed from the direction BB,

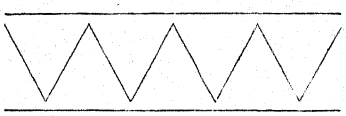

FIG. 2.

the effect of foreshortening is to give it the visual appearance of Fig. 3. To obtain

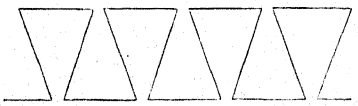

FIG. 3.

satisfactory results, the eye should be at a convenient distance from the picture at a height only slightly higher than that of the table.

[4] That when viewed from a distance a set of disconnected lines may look as if they were joined and formed a continuous pattern has been noticed by the Samskrit Poet and Dramatist Kalidasa: Vide *Abhignana Sakuntala*, First Canto, Verse 9.

OBITUARY

Mr. N. G. Majumdar, M.A., F.R.A.S.B. (1897–1938)

WE regret to announce the sad and untimely death of Mr. Nani Gopal Majumdar, M.A., Special Officer for Exploration of the Archæological Survey of India, who was murdered under most tragic circumstances on 11th of November 1938, near Johi in the Dadu District of Sind. Mr. Majumdar was deputed from 1st of October 1938 for a period of six months to complete a survey of the prehistoric sites of the Indus Valley Civilization which he had so successfully carried out from 1927–31. Soon after starting work in Upper Manchar Lake area, he was shot dead on the morning of the 11th November by a band of armed dacoits which attacked his camp.

Majumdar was the eldest son of Dr. B. Majumdar of Jessore, and was born on the 1st of December 1897. After a successful scholastic career he passed the B.A. Examination with Honours in Sanskrit in the first division of the Calcutta University and was awarded a Silver Medal and a scholarship. In 1920 he passed the M.A. Examination in Ancient Indian History and Culture in the first division and was awarded a Gold Medal for securing the first rank. His post-graduate studies in the newly organised Ancient History Department of the University were devoted to researches in Sanskrit and Epigraphy, and he derived full benefit from his association with teachers of the calibre of the late Mahamahopadhyaya Haraprasad Shastri, C.I.E., and Professor D. R. Bhandarkar. *En passant* it may be mentioned that it was apparently the

influence of Professor Bhandarkar, the late Mr. R. D. Banerjee and Rai Bahadur Rama Prosad Chanda which was responsible for his developing a keen interest in Indian Archæology. During 1921–23 he was awarded the Griffith Memorial Prize for an interesting thesis on *Vajra*, the Mouat Gold Medal and the Premchand Roychand Scholarship which is the blue ribbon of the Calcutta University awards for a thesis entitled *A List of Kharoshthi Inscriptions.* While carrying on post-graduate studies he was appointed on the staff of the Ancient Indian History and Culture Department of the Calcutta University and continued in this capacity till 1924 when he was selected for the post of Curatorship of the Varendra Research Society, Rajshahi, Bengal. During the period of his curatorship he published a monumental volume entitled "Inscriptions of Bengal," Vol. 3, and as a result of this and other archæological works he was selected in 1925 for archæological training by Sir John Marshall, the then Director-General of Archæology in India. He was later deputed to Mohenjo-Daro where a Chalcolithic culture of the prehistoric times had recently been discovered. After this training he was appointed as Assistant Superintendent for Exploration in the Archæological Survey in June 1927, and the first important work carried out by him was a survey of the centres of the prehistoric civilization of Sind. On the 1st of June 1935 he was appointed Superintendent of the Archæological Section of the Indian Museum. This post he held till the 1st of October 1938 when he was placed on special duty to complete his survey of the prehistoric sites in Sind. In the Indian Museum he re-organized the archæological galleries of the Museum on modern lines, and entirely rearranged the prehistoric gallery. He also published two valuable guides to the collections in the Indian Museum, one dealing with the sculptures of the early schools and the other on the Gandhara sculptures. While stationed at Calcutta, he also carried out excavations at various archæological sites, such as Lauriya-Nandangarh (Champaran Dist.), Kosam (Allahabad Dist.), Durgapur (Burdwan Dist.) and several other sites in Bengal. In addition, he deciphered and edited a large number of *Brahmi* and *Kharoshthi* inscriptions which have thrown considerable light on a number of complicated problems of Indian History.

Mr. N. G. Majumdar, M.A., F.R.A.S.B.

Mr. Majumdar was one of the most distinguished products of the modern school of Archæology in India, and was a very versatile scholar. The published results of his work bear ample testimony to his knowledge and the varied nature of his interests in the different branches of Indian Archæology. He was also a recognised authority on the early history of India, and presided over the History Section of the Prabasi Vanga Sahitya Sammilan held at Patna in December 1937.

Most of his earlier work was published in the *Indian Antiquary* and *Epigraphia Indica,* while his famous memoir "Explorations in Sind" was published in 1934 as Memoir No. 48 of the Archæological Survey of India. He contributed a valuable paper on the Copper Coins from the Stupa area in *Mohenjo-Daro and the Indus Civilization,* and a chapter dealing with the inscriptions of Sanchi is being published in the *Monuments of Sanchi.* In addition, a large number of his papers dealing with *Brahmi, Kharoshthi* and later inscriptions have been published in the *Epigraphia Indica.* An interesting contribution of his to the India Society's publication heading *Revealing India's Past* (which is now in the press) deals with prehistoric and protohistoric civilization.

He joined the Royal Asiatic Society of Bengal as an Ordinary Member in June 1920 and was elected a Fellow in February 1936; he was probably the youngest Fellow to enjoy this great honour. He also served on

the Council of the Society for a number of years. By his early death the Society has lost an active member and an outstanding scholar in the very prime of his life. Whatever branch of Archæology he touched he left his mark.

Mr. Mahes Prasad Bajpai (1907–1938)

MR. M. P. BAJPAI, who was Lecturer in Geology in the Department of Ceramics, Benares Hindu University, met with a fatal accident near Lachhman Jhula in the Almora District, United Provinces, on the evening of the 15th November 1938. He was out in field on behalf of the Government of the United Provinces to whom his services were lent by the University and was carrying out prospecting work under the newly planned Mineral Survey of the Province. It seems, while climbing a steep escarpment on way to a gypsum quarry he fell deep down into a gully and died instantaneously due to the fracture of the skull. The entire details of the accident are not known.

Mr. Mahes Prasad Bajpai

Mr. Bajpai was born in 1907 in the Etawah District, United Provinces, and had his Secondary education in the Local High School. In 1924 he joined the Benares Hindu University where he studied Geology and eventually passed the M.Sc. Examination in that subject in 1930. After this, he took to research and investigated a number of problems many of which were of economic importance and aimed at the development of the mineral industry of the country. He carried out mineral prospecting in several States and many districts of the United Provinces, Central Provinces, Bihar and Madras Presidency and discovered a large number of new mineral deposits which included mica, felspars, pottery clays, limestones, talc, glass sands, etc.

In the brief span of six years as a geologist, he published a large number of papers both of academic and economic importance. His work on Gwalior Trap has been of outstanding value and will remain a work of reference for a long time. Much of his work on the Cuddapahas is yet left unpublished. During the last monsoon he, along with a colleague from the Department of Geology, surveyed the flooded districts of the United Provinces and investigated the causes of these floods in this area. He was busy writing the report suggesting measures for preventing the occurrence of these floods which are so frequent in our country and devastating in their nature. Although very young, his researches on clays brought him on the Editorial Board of the *Indian Ceramics*, a newly started quarterly journal.

Mr. Bajpai was a keen sportsman and an excellent field-geologist. Even under the most trying circumstances, he would not hesitate in pursuing arduous work. He felt homely alike in the hot sandy deserts of Cutch, the barren hills of the Salt Range and in the cold hills of the Siwaliks. His enthusiasm and zeal for work was endless. In his premature death at the young age of 31 years, our country has lost a promising geologist.

A. G. J. AND M. L. M.

WE regret to announce the death of Dr. A. S. Menon, D.Sc., Lecturer in Physical Chemistry, Annamalai University, Annamalainagar at the early age of 35.

LETTERS TO THE EDITOR

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Radiating Masses in Einstein's New Relativity

IT is well known that the field equations of general relativity have not yet provided a satisfactory mechanics of radiating masses. Following the ideas of classical relativity it has been shown by the author[1] that even radiating small masses trace geodesies. However, according to the recent developments of general relativity, largely due to Einstein[2] and his collaborators at Princeton, the geodesic-postulate is extraneous and the field equations themselves ought to give both matter and motion. The question now arises as to whether the new theory explains the problems of radiating masses such as (i) the external field of a radiating mass or (ii) the motion of a radiating mass in the field of another. The latter problem is of great astronomical interest in connection with the evolution of binary stars.

It is found that the new exposition of general relativity fails to explain the mechanics of radiating masses. This comes out, moreover, in a way, not anticipated by Einstein and his collaborators. It is not possible to give here all the details but the crux of it is that, in the problem of p bodies, the following equation (1938 2b, §9) is obtained:

$$\underset{3}{\gamma_{on,\,n}} = \underset{2\;1}{\gamma_{oo,\,o}} = \sum_{k=1}^{p} \left(-4m \Big/ \overset{k}{r} \right)_{,\,o} \qquad (1)$$

Einstein and his collaborators now remark: "This equation can be solved without introducing new singularities only if $\dot{\overset{k}{m}} = 0$. In other words, the quantities $\overset{k}{m}$, which actually measure the masses of the point singularities, are necessarily constant".

What needs to be pointed out here is that if we use the time-equation of motion for the kth particle (1938 2b, §7) we get from (1) itself

$$0 = \underset{3}{\overset{k}{C}}_{o} = \frac{1}{4\pi} \int^{k} (\underset{2\;1}{\gamma_{oo,\,on}} - 2\,\underset{3}{\Lambda_{on}}) \cos(n \cdot \mathrm{N})\, dS = \dot{\overset{k}{m}} \qquad (2)$$

Hence m must necessarily be constant, that is, the masses must be necessarily non-radiating, which we get without attempting a solution of (1).

The failure to incorporate non-static masses in the treatment of the new as well as classical relativity must be attributed either to the field equations or to the condition at infinity, *viz.*, that the field is Galilean there. A Galilean field at infinity is necessary for the conservation of energy of any isolated material system;[3] and so, if the joint system consisting of radiating masses and outgoing radiation satisfies the principle of conservation, space-time is expected to be flat or Galilean at infinity.

V. V. NARLIKAR.

Benares Hindu University,
December 8, 1938.

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[1] Narlikar, V. V., *Nature*, Oct. 15, 1938, **142**, 717.

[2] (*a*) Einstein, and Risen, *Phys. Rev.*, 1935, **48**, 73.
(*b*) Einstein and others, *Ann. of Maths. Zs.*, 1938, **39**, 65-100.
(*c*) Infeld, L., *Phys. Rev.*, 1938, **53**, 836.

[3] Tolman, *Rel. Thermo. and Cosmo.*, 1934, 228,

Molecular Oscillation Frequency in Viscosity and Raman Effect

CALCULATIONS of viscosity on the basis of Andrade's theory have so far been made in the case of monatomic substances, whose frequencies of molecular oscillation are computed from Lindemann's expression. The viscosity η of such a substance at its melting-point is given by the formula:

$$= \frac{4}{3}\frac{M}{\sigma} \times 2{\cdot}8 \times 10^{12}\sqrt{\frac{T_s}{MV^{2/3}}} \quad .. \quad (i)$$

More generally, for all substances including compounds we will assume that M denotes the molecular weight, V the molecular volume, T_s the melting-point and σ the mean distance between molecular centres. Calculating viscosity values for a number of organic substances from the formula (i), a fair agreement between the observed and the computed values is noticed.

TABLE I

Substance	η Calculated from (i)	η Observed*	Ratio $\frac{\eta \text{ Obs.}}{\eta \text{ Cal.}}$
Heptane ..	·002472	·00253	1·02
Pentane ..	·002223	·00256	1·15
Octane ..	·002648	·00244	0·92
Propyl Chloride ..	·002770	·00352	1·27
Propyl Bromide ..	·003574	·00388	1·08
Propyl Iodide ..	·004058	·00420	1·03
Carbon tetrachloride	·004811	·00654	1·35
Chloroform ..	·004278	·00465	1·08
Benzene ..	·003766	·00391	1·03
Ethyl Benzene ..	·002817	·00282	1·01
Ethyl Sulphide ..	·0027·5	·00279	1·01
Carbon Bisulphide ·	·003715	·00267	0·99
Propyl Acetate ..	·002895	·00304	1·05
Methyl Formate ..	·003387	·00384	1·13

* Macleod, *Proc. Phys. Soc.*, 1938, **53**, 788.

The mean value of 1·08 for the ratio indicates the general applicability of Lindemann's expression. Further the Lindemann frequency which is generally accepted to coincide with the Debye maximum frequency or the Reststrahlen frequency often gives rise to a Raman line in the scattered radiation from such monatomic substances as diamond, phosphorus, sulphur, etc. Some of the Raman lines observed close to the Rayleigh line by Gross and Vuks[1] as well as Sircar and Gupta[2] in some organic crystals seem to arise from the same source.

TABLE II

Substance	ν Calc. in cm.$^{-1}$	ν Obs. (Raman Spectra) in cm.$^{-1}$
Diamond	1302	1332
Calcium Fluoride ..	330·6	322
Sodium Chloride ..	195·9	235
p-Dibromobenzene ..	23·32	20·1
p-Dichlorobenzide ..	30·03	27·6
Naphthalene	36	42
Ammonium Chloride ..	171	160
Phosphorus	27·5	36
Sulphur	88	85
Mercurous Chloride ..	316	312
Aragonite	107·3	94

The existence of the Lindemann or the Debye maximum frequency in the scattered spectra favours the view that the Raman lines close to the Rayleigh line arise from lattice oscillations.

L. SIBAIYA.
M. RAMA RAO.

University of Mysore,
Central College,
Bangalore,
December 19, 1938.

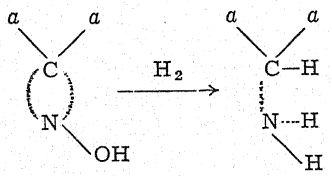
[1] Gross and Vuks, *Nature*, 1935, **135**, 998; *Journal de Phys. et le Radium*, 1936, **7**, 113; and Vuks, *C.R. de l'Acad. des Sc., U.S.S.R.*, 1936, **1**, 72.

[2] Sircar and Gupta, *Ind. Jour. Phys.*, 1938, **12**, 35–46; and 1936, **10**, 473.

The Space Configuration of Nitrogen in the 3-Covalent State

THE configuration of nitrogen compounds of the ammonia (NH_3) or amine (Nabc) type has been an outstanding problem in stereochemistry. There are two alternatives: (*a*) the nitrogen atom lies in one plane with the three attached groups, so that the molecule has a plane of symmetry; (*b*) it does not lie in that plane, in which case the molecule has a spatial configuration.

On the latter hypothesis, compounds of the type Nabc should exist in enantiomorphous forms. This has never been observed. Evidence from physical properties of ammonia or amines, however, clearly supports the view that in these compounds, the nitrogen atom does not lie in one plane with the three attached groups. The object of this note is to furnish an unequivocal answer to this question from stereochemical evidence. The work of Mills[1] on centro-asymmetric oximes and hydrazones has conclusively proved that the doubly linked valencies of nitrogen in the oxime grouping are not coplanar with the singly linked one (I), thus:



(I) (II)

On reduction, an oxime (I) gives the corresponding amine (II). If in the molecule of the oxime, under consideration, the plane containing the doubly linked valencies of nitrogen does not *originally* contain the singly linked valency, carrying the hydroxyl group, the position of the latter linkage will remain unaltered relatively to this plane which now contains two single valencies in the resulting amine (II) in place of the original doubly linked valencies (I). In other words, the three valencies of the nitrogen atom in an amine are not coplanar. Figs. 1 and 2 are photographs of the models of an oxime and the corresponding amine: one of the two large connected spheres (Figs. 1 and 2) represents the carbon atom, and the other, the nitrogen (striped), to which

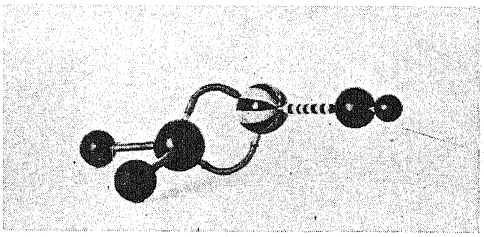


FIG. 1

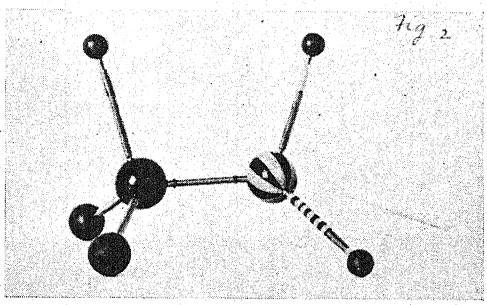


FIG. 2

a smaller sphere representing the oxygen atom is attached; the latter carries a still smaller sphere, representing the hydrogen atom. The striped link, carrying the spheres representing the hydroxyl group, is shown lying outside the plane containing the two links representing the double bond (Fig. 1). It is clearly seen that this link still lies outside the plane, containing the two single links, resulting from the double link, in the corresponding model of the amine (Fig. 2). A fuller account of this work will appear elsewhere.

BAWA KARTAR SINGH.

The Chemical Laboratories,
Science College, Patna,
October 26, 1938.

[1] Mills and Bain, *J. C. S.*, 1910, **97**, 1866; Mills and Saunders, *ibid.*, 1931, 537.

The Endo-Enzyme in Tea Fermentation

THE study of the enzyme system responsible for the 'fermentation' of tea, has been so far conducted on the enzyme extracts using aqueous solvents. Both oxidase and peroxidase

actions have been observed in these extracts,[1,2,3,4] and it is still unknown whether what partakes in the reaction is either one or both of these enzymes.

In addition to these soluble enzymes, however, it has now been found that tea leaf contains an endo-enzyme which is insoluble in the usual aqueous solvents for enzymes. Thus, extraction of the suitably prepared leaf with water, buffer and glycerine solutions still leaves behind an active enzyme, which would also appear to react during fermentation on the polyphenolic substrate.

The presence of this endo-enzyme can be demonstrated as follows:—

The leaf is well ground with sand under acetone and filtered, repeating the operation several times until all the colouring constituents are extracted. The residue, which is almost colourless, is dried in vacuum, thoroughly extracted with solvent buffer solution and washed well. The insoluble leaf tissue thus obtained gives all the reactions familiar to tea fermentation with a tea extract or theotannin isolated according to the method of Shaw.[5]

To indicate the activity of the insoluble enzyme the supernatant liquid is drained off, the residue washed free of colour, and a fresh tea tannin solution added when again the orange red colour is produced.

Sufficient evidence is at hand to show that this enzyme, which is an oxidase in its nature, is different in characteristics from the soluble tea enzyme. Apart from the obvious solubility differences, it would appear to have an optimum pH between 5·0 and 5·5 and withstands concentrations of KCN up to M/50, the usual oxidase or peroxidase being inactivated far below this concentration. Further, the endo-enzyme acts on high concentrations of tea tannin which, it is shown, would inhibit the action of soluble enzymes. The reaction mixture itself with tea tannin has a bright orange red colour identical with the 'tint' of the liquor obtaining when the fermented leaf is infused.

The further nature of this endo-enzyme, the exact mechanism of its action, and the actual role it plays in 'fermentation', are being investigated.

H. B. Sreerangachar.

Biochemical Laboratories,
Tea Research Institute of Ceylon,
December 17, 1938.

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[1] Mann, H. H., "The Ferment of the Tea Leaf, Parts I, II and III," *Indian Tea Association, Scientific Department*, 1901, 1903, 1904.
[2] Oparin, *et. al.*, *Biochemical Aspects of Tea Industry, Georgia, U.S.S.R.*, 1935, 107.
[3] Kursanov, *ibid.*, 1935, 125.
[4] Roberts, E. A. H., and Sarma, S. N., *Biochemical Journal*, 1938, **32**, 1819.
[5] Shaw, W. S., *U.P.A.S.I., Bull.* No. 4 (*a*), 1935.

A Note on the Modification of Shellac with Organic Acids

It has been recognised that shellac is mostly composed of hydroxy acids in the form of condensed esters, lactides or lactones. From the constitution of shellac so far understood, it can be said to contain five hydroxyl groups and at least one carboxyl group. The predominance of a large number of hydroxyl groups, free and combined, led to the idea of modifying shellac by esterification with several organic acids and subsequent reduction of residual acidity by combining the esters with mono or polyhydric alcohols. Such combinations might have specially water and heat resistant properties, an expectation fully confirmed by the results of actual experiment.

Shellac was condensed with several organic acids like maleic, phthalic, succinic, adipic, butyric, malic, etc. Later, phosphoric and boric acids were also included in the list, and useful products were obtained. The condensations could be brought about directly or in the presence of solvents and non-solvents of shellac. The alcohols investigated for reducing the final acidity of the condensation products include glycols, glycerine, butyl alcohol, etc. The modifications possess various degrees of hardness, elasticity and adhesion. A typical preparation with maleic acid which (without the final condensation with alcohols) has given promise of an extended use of shellac for special varnishes, is described below.

A 40 per cent. solution of shellac in industrial alcohol (filtered free of wax) and 5 per cent. maleic acid on the weight of shellac are refluxed for 3–4 hours over a water-bath and cooled. Air-dry films of this varnish on glass and metal sheets possess improved adhesion, gloss, elasticity and water resistance.

Films from varnishes treated with maleic acid and control varnish were prepared on copper sheets (0·065 mm. thickness) caked at 120° C. for 18 hours and examined for appearance, adhesion and flexibility. The following are some of the results:—

chemical action of shellac on copper (as evidenced by the absence of greening effect) even on prolonged baking, say 18 hours at 120° C. In general, baking such films for a short time at 100–110° C. confers better mechanical and water-resistant properties without causing pinholes or blisters. As example of practical applications, it has been found that aluminium and tin foils coated with such coloured lacquer do not peal off or show cracks on repeated bending, twisting or folding; electric bulbs dipped in the lacquer stand up to weathering without fading of colour or cracking of the

TABLE I

	Appearance	Bending test
Control-varnish	Mottled and Greenish	Poor adhesion and flexibility
,, ,, heated	,,	,,
,, ,, ,, with 0·5% Maleic Acid ..	Smooth film, no green colouration	Good elasticity and adhesion
,, ,, ,, ,, 5·0% ,, ..	,,	,,
,, ,, ,, ,, 10·0% ,, ..	,,	Poor adhesion and flexibility
,, ,, ,, ,, 20·0% ,, ..	,,	,,
,, ,, ,, ,, 40·0% ,, ..	,,	,,

Uniform films from the same varnishes were next prepared on glass slides and their resistance to water was measured qualitatively. Table II summarises the observations made.

When an alcohol-soluble dye is dissolved in such a varnish, the resulting lacquer has superior colour fastness on exposure to light and heat. Maleic acid treatment also prevents the film. Such a varnish could be used also for furniture polish.

It has also been found that varnishes from such modified shellac could be plasticised with 5 per cent. glycol phthalate or castor oil resulting in a further improvement in elasticity without deterioration in properties such as water resistance, etc. If, however, more than

TABLE II

Behaviour of films on glass after immersion in water

	4 hours	24 hours	1 week
Control-varnish	Blush	Blush	Blush
,, ,, heated	Slight blush	,,	,,
,, ,, ,, with 0·5% Maleic Acid ..	No blush	No blush	No blush
,, ,, ,, ,, 5·0% ,, ..	,,	,,	,,
,, ,, ,, ,, 10·0% ,, ..	,,	Slight blush	Slight blush

5 per cent. castor oil is used, the resulting varnish coated on copper darkens on baking.

It should be mentioned that addition of more than 5 per cent. of maleic acid to the shellac results in poorer adhesion and elasticity in the varnish film.

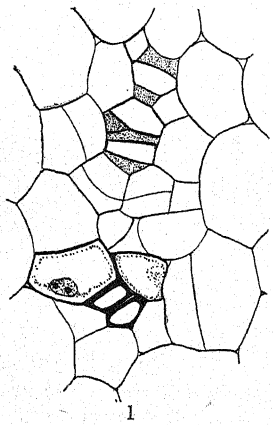
M. VENUGOPALAN.

Indian Lac Research Institute,
Namkum,
May 25, 1938.

Intrafascicular Cambium in a Monocotyledon

RECENTLY, while studying the floral morphology of *Iphigenia indica* Kunth (Fam. Liliaceæ), collected from Krusadai Island, South India, I have come across distinctly active intrafascicular cambium in several parts of the plant. I first observed this in the pedicel, and Figs. 1 and 2 reproduced here are from this organ. Later I observed similar intrafascicular cambium in the vascular bundles of the bracts, young leaves and the nodal regions of young stems. The cambium differentiates along with the primary xylem and primary phlœm (Fig. 1), as in a dicotyledonous bundle, and functions in the same manner, forming secondary xylem to the inside and secondary phlœm to the outside (Fig. 2), but the amount of the two tissues varies somewhat in different bundles. In some cases, the intrafascicular cambium gives rise to almost equal amounts of secondary xylem and second phlœm, as is the case in Fig. 2, but in others it forms more of secondary xylem or phlœm.

The occurrence of intrafascicular cambium in the Liliaceæ has already been recorded in *Hemerocallis*,[2,4] *Allium*,[1,4] *Lilium*,[1] *Dracœna*,[1,6] *Gloriosa*,[9] *Orinthogalum*,[8] *Yucca*,[10] *Milla*,[10] *Dipcadi*,[10] *Galtonia*,[10] *Albuca*,[10,4] *Fritillaria*,[10] *Eremurus*,[2] *Asparagus*,[2] *Nothoscordum*,[2] *Ophiopogon*,[3] *Phormium*,[3,4] *Veratrum*,[3,4] *Anthericum*,[4] *Arthropodium*,[4] *Colchicum*,[4] *Hyacinthus*,[4] *Kniphofia*,[4] *Scilla*,[4] *Smilax*,[3] *Rhipogonum*,[5] *Asphodelus*[5] and some other genera,[7] but there is no previous record of its occurrence in the genus *Iphigenia*.



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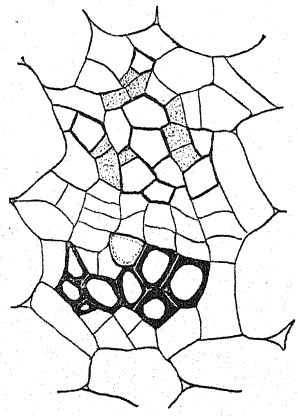

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FIGS. 1 and 2. *Iphigenia indica*

Vascular bundles from transverse sections of two pedicels of different ages. Fig. 1, a young bundle showing differentiation of primary xylem, primary phlœm and intrafascicular cambium. Fig. 2, an older bundle, showing the formation of secondary xylem and phlœm. × 700.

A. C. JOSHI.

Department of Botany,
Benares Hindu University,
December 12, 1938.

1 Anderson, S., *Bihang till k. Svenska Vet. Akad. Handl.*, 1888, **13.**
2 Arber, A., *Ann. Bot.*, 1917, **31.**
3 Arber, A., *ibid.*, 1918, **32.**
4 Arber, A., *ibid.*, 1919, **33.**
5 Arber, A., *ibid.*, 1922, **36.**
6 Dauphiné, A., *Ann. Sci. Nat. Bot. ser.*, ix, 1917, **20.**
7 Gatin, V. C., *Rev. Gen. de Bot.*, 1920, **32.**
8 Lonay, H., *Mem. Soc., Roy. Sci. Liege, ser*, iii, 1902, **4.**
9 Queva, C., *Trav. et Mem. de l'Univ. de Lille*, 1899, **7.**
10 Sargant, E., *Ann. Bot.*, 1908, **22.**

REVIEWS

The Stuff We're Made of. By Dr. W. O. Kermack and Dr. P. Eggleton. (Edward Arnold & Co., London), 1938. Pp. 342. Price 7*s.* 6*d.* net.

"A preposition is a word that you must not end a sentence with", said the professor; but Drs. Kermack and Eggleton, supported by so high an authority as H. W. Fowler, evidently claim that the legitimacy of a prepositional ending in literary English must be uncompromisingly maintained. The excellence of their book entitles them to this dictatorship.

A very successful attempt has been made to delineate in detail the building materials of the body, and the chemical processes by which the body works. It begins with an appeal to the sense of proportion invoked by an ingenious yardstick of the universe in which the unit is the proton. Ascent of the scale by one unit corresponds to multiplying the previous number of protons by 10. Thus at 6 on the scale we have reached 10^6, or one million protons; a red blood-cell stands at 14, a whale at 32, the world at 51·6 and the sun at 57 on the scale. This helpful idea is elaborated in the frontispiece, "From molecule to nebula", comprising six objects, each of which is about one billion times (10^{12}) as large as the next in series.

There follow chapters on the methods of pursuing a scientific inquiry, and the underlying principles of molecular architecture, leading to the nature and sources of energy with special reference to the animal body. On this compact foundation is developed the purpose of the book, namely, to portray the relationship between living and non-living matter, thus proceeding to an admirable account of recent biochemical researches in simple terms illustrated by intelligible formulæ.

From this we learn of the things we must eat, of the vitamins, of the enzymes—"Nature's stepping-stones"—and of the hormones in relation to reproduction and growing-up. A chapter entitled "Chemical Makeshifts in Nature" concludes with an illuminating survey of the skeletal kinship among the sterols, œstradiol, testosterone, calciferol, cholic acid, strophanthidin and methylcholanthrene, one of the most active of the cancer-producing compounds. The chapter called "No-Man's-Land" is an enlightening discourse on the scale-region below 10, embracing bacteria, the viruses and bacteriophages; whilst the conclusion is pleasantly philosophical, showing that the development of general scientific study, of biochemistry and physiology in particular, tends to weaken the vitalistic view-point which claims that living matter displays phenomena basically different from those of inorganic nature.

The authors have contrived a most commendable art of exposition. They use diverting expressions and plain language to convey elusive ideas and complicated changes, thus producing an exceptional book which, at the very modest price of issue, constitutes a genuine mine of information and stimulation.

M. O. F.

Testing Television Sets. By J. H. Reyner. (Chapman & Hall, Ltd., London), 1938. Pp. vii + 128 with 49 figures. Price 9*s.* 6*d.* net.

This book on the testing of television receivers by an experienced radio engineer and writer like Mr. J. H. Reyner is an indication of the present status in Great Britain of the development of television as a public service. With advances in the transmission service, there has been a gradual increase in the number of television receivers in public use; and these have to be maintained in satisfactory working condition by efficient servicing.

Mr. Reyner's book is primarily designed for the service engineer who is at home with the basic principles of television transmission and reception. It is not just a bundle of notes but deals intelligently and briefly with the theory and design considerations underlying the troubles that normally arise in practice in a television receiver. Mr. Reyner analyses the causes of defective operation and failure occurring in each of its component parts and describes the methods of locating them and the measures necessary to set them right. In several cases, sample calculations have been worked

out to illustrate the method. A considerable part of the book is necessarily taken up with the cathode-ray tube—both electrostatic and electromagnetic—and its associated apparatus such as the time base and synchronising circuits. The excellent reproductions of the pictures on the screen bring out clearly the different types of distortion described in the text.

A word of praise is due to Mr. Reyner for the many practical hints and advice that he gives as well as for his emphasis on a number of precautions in testing. Amongst these are the damage to the cathode-ray tube screen by a stationary spot (page 25), the discharge of condensers through a resistance (page 23), the precaution against electrical shock by keeping one hand in the pocket when testing with the other (page 21). There are a number of circuit diagrams, the usefulness of which is enhanced by the values of the electrical constants of the component parts. And special mention must be made of the first and last chapters dealing with apparatus and technique necessary for testing television receivers.

Amongst so many good and useful features, there are a few minor defects. For example, what exactly is meant by the opening sentence in Chapter II? Such terms as "h.t. voltage" (page 32, line 20), "bottombending" (page 59), "shorting" (page 64), etc., are rather inappropriate in a book, whatever their justification in conversation. So also the technical jargon in the second para on page 57. One must demur against the statement that the charging current is proportional to the charge (page 55) and the definition of time constant on page 57.

RE

Ions, Electrons and Ionizing Radiations. By J. A. Crowther. (Edward Arnold & Co., London), 1938. Seventh Edition. Pp. 348. Price 12*s.* 6*d.*

Every student of Physics is familiar with this book which has already gone through a number of editions. As the author himself puts it, as a result of the unparalleled outbursts of discovery, experimental and theoretical, of the past twenty years, the book has undergone many changes. Its purpose, however, remains unaltered.

The sections on Cosmic Rays and the chapter on the Nucleus are most interesting and instructive. They have been rewritten and very considerably enlarged. The presentation of the subject is systematic and fully indicates the very rapid advances made in these branches.

The book is one of the best on this subject and as a study-book for the college student, it occupies a particularly very high position.

The conclusions of modern researches are mentioned in the text, without, in most cases, going into their mathematical details. This helps the student to be generally well-acquainted with the most important topics of the day.

A special chapter dealing with atmospheric electrictiy, specially dealing with the recent work on ionosphere and the like would considerably add to the value of the book.

One of the principal features of the book is the balanced treatment of all the different branches of the subject and the systematic plan which maintains the link between them all.

G. R. P.

An Introduction to the Chemistry of Cellulose. By J. T. Marsh and F. C. Wood. (Chapman & Hall, Ltd., London), 1938. Pp. xv + 431. Price 21*s.* net.

Considering the technical importance of cellulose and its derivatives, there are few books on the subject and the present volume is an extremely valuable addition. Written by two members of the research staff of the Tootal Broadhurst Lee Co., Ltd., a firm which has been one of the pioneers in the application of chemistry to the processing of textiles, the book is an authoritative survey of every aspect of the chemistry of cellulose. Almost the only criticism that one might offer is that, in common with several other recent books on chemical technology (particularly of American origin), clarity is sometimes sacrificed in an effort to be comprehensive in the citation of literature. One might also add that in an *Introduction to the Chemistry of Cellulose* experimental details are best omitted, unless these relate to methods which have been accepted as the standard; in a subject such as this, in which the bulk of the work has been very recent and in which a great deal of the published material is of an inconclusive and empirical character, few procedures could claim to have attained the status of standard methods. Although the original literature on cellulose is vast and

complex, the research worker in the field will perforce have to wade into it, so far at least as his immediate problem is concerned, and there is little to gain by attempting to include in a general and introductory survey a detailed account of experimental procedures. Further, in making a choice of methods meriting full description, a slight tendency towards insularity seems difficult to avoid.

A very pleasing feature of the book is the stress laid on the practical applications of cellulose chemistry. The references to patent literature are extensive and every important development in the preparation and utilisation of cellulose derivatives has found a place. For any one desiring to undertake a study of the esters and ethers of cellulose, there could be no better starting point than Part IV of this book.

A few minor omissions may be noted. In dealing with the dispersion of cellulose, no reference is made to a commercially available organic solvent marketed by Röhm and Haas. The expression "degree of mercerisation" is loosely employed; while there are tests for characterising mercerised cotton, of which the baryta number is the most reliable, none has yet been shown to be adequate for a quantitative estimation of the "degree of mercerisation", apart from a photometric assay of the lustre. Edelstein's very useful work on the influence of temperature and other factors in mercerisation has escaped notice. So have Sauter's conclusions on the unit cell of cellulose, preferring the Sponsler lattice to that of Meyer and Mark. Hudson's researches on the graduated fission of carbohydrates by means of periodic acid might have received fuller treatment than the brief reference to "the interesting speculations on the chemistry of oxycellulose formation".

This is a book for every textile chemist and every cotton mill in the country to possess.

K. V.

Life-Histories of North American Birds of Prey (Part 2). By Arthur Cleveland Bent. (*Bulletin 170 of the Smithsonian Institution, United States National Museum, Washington*), 1938. Vol. 8. Pp. viii + 482, 92 plates. Price 60 cents.

This is the eleventh of the series of bulletins on the life-histories of North-American birds, which so far includes Wildfowl, Marsh Birds, Shore Birds and Gallinaceous Birds. The excellent manner in which Mr. Bent has sifted, collated and marshalled the wealth of information at his disposal makes these publications of the highest value to students of birds, not only in America but also throughout the world, particularly to those interested or engaged in conducting research in Economic Ornithology. It was precisely such comprehensive investigations on the life-histories of Indian birds, as a groundwork for more specialised studies, that were contemplated in a scheme for research in Economic Ornithology submitted by the Government of Bombay to the Imperial Council of Agricultural Research about three years ago. After some deliberation, the scheme was turned down by that body, ostensibly for financial reasons, since it was made clear at the outset that the work would, of necessity, have to remain unremunerative in its early stages. It is not heartening to workers to find facilities blocked due to such a short-sighted and commercial view of scientific research not uncommonly taken in this country. The ever-ready—and often convenient—plea of "financial stringency" is an argument which it is always difficult to meet!

The present volume deals with 20 species and subspecies of the Order Falconiformes, all belonging to the Family *Falconidæ*, and 56 species and subspecies of the Order Stringiformes comprising the Families *Tytonidæ* and *Strigidæ*. As full a life-history as possible has been given of the best known subspecies of each species. Duplication is avoided by writing briefly of the others and giving only the characters of the subspecies, the range, and any habits peculiar to it. "Life-history" covers: Courtship, Nesting, Eggs, Nestling, Young, Plumages and Moults, Food, Behaviour, Voice, Enemies, Seasonal Movements, Spring and Autumn Migrations, Range, Breeding Range, Casual Records, etc.

The compilation of such a comprehensive manual—and the others of this series—has naturally only been made possible by the co-operation of a large number of scattered observers. The magnitude of the task will be appreciated when it is realised that receipt of material from close on 400 contributors has been acknowledged. The distribution paragraphs have been compiled from the matchless files of the Bureau of

Biological Survey and are as authentic and up-to-date as it is possible to have them.

The 92 plates accompanying the volume are well-chosen and depict nests, eggs, nesting sites and young of falcons and owls in their various plumage stages. The very full and useful bibliography, covering 22 pages, is another feature for which students will be thankful.

There is a great deal that workers in India will find suggestive in this monumental series of life-histories of American birds. The volumes cannot but serve as an inspiration, and must form a very desirable adjunct to every ornithological library.

SALIM ALI.

Chemical Tables from Handbook of Chemistry and Physics. (Published by the Chemical Rubber Publishing Co., Cleveland, Ohio). Price $3.

The original *Handbook of Chemistry and Physics* published by the same Company, has been a well-known reference book of proved utility to many individual physicists and chemists. The wide range covered by its contents and the very reasonable cost at which the book has been available are its significant features. In its succeeding editions, however, including the last 22nd edition for 1937–38, the book has grown to over 2,000 pages and this has tended to make the handling of this *Handbook* somewhat inconvenient. At the suggestion of several prominent users, the publishers have now separated out the portions immediately useful to the chemists, into a convenient-sized volume of "Chemical Tables", while, at the same time, incorporating some additional features such as Melting point and Boiling point index, tables of Free energies, Ionisation potentials, etc.

This new form of the well-known *Handbook* will, no doubt, be even more welcome to the large circle of chemists. The price of this volume in India is only 3 dollars; and for this price, the fare provided is, indeed, very liberal.

M. A. G. Rau.

Modern Atomic Theory. By J. C. Speakman. (Edward Arnold & Co., London), 1938. Pp. 207. Price 6*s*. net.

In the *Preface* to this book the author says that it has been written with a view to its being useful to science students in universities and colleges and in the upper forms of schools and possibly to the general scientific readers as well. The reviewer has no hesitation in saying that this object has been amply fulfilled. A logical treatment of a subject that is progressing rapidly, is in the nature of things, a difficult process but the author's efforts in this direction have been very successful. Stress has been laid on the physical principles underlying the atomic phenomena and the treatment is non-mathematical. A student desiring to specialise, is enabled to build up the proper perspective necessary for the study of a subject of such fundamental importance. The tables given, make the book useful for ready reference as well. The very clear presentation of the whole subject makes it easy for the general scientific reader to acquaint himself with the nature of atomic processes. The treatment is accurate and agreeably concise. A bibliography of select books has been given in the end for the benefit of those who desire detailed information. The illustrations and the index add to the value of the book.

D. S. R.

The German Primer for Science Students. By H. Biswas. (University of Calcutta), 1938. 9½″ × 6″. Pp. 258.

While science is international the language in which its results are expressed is not so. This is an unavoidable obstruction which can only be got over by a student of science by learning several languages. It is a known fact that nowadays German is the medium in which the largest quantity of research-output is expressed in any single language. Hence the minimum equipment for a student of science should include a knowledge of German. But the chief modern language which an Indian student learns at school is English. Hence he has usually to pick up German at the post-graduate stage, when he has hardly time or inclination to take a formal course.

The value of Biswas's *German Primer* is best seen in this setting. It is pre-eminently "German self-taught". It has all the merits due to its being based on the concrete experiences of a student of science who had struggled to acquire this language and has achieved full success. It is indeed very good of Biswas to place the benefit of his achievement at the disposal of other students of science.

After developing the essentials of grammar in a human way in the first 59 pages the author has devoted a section to literature and one to each of the important sciences. These sections contain the special vocabulary of the field covered and illustrative passages with English translation. The book ends with about 50 pages of a select vocabulary of words common to all sciences and literature. The illustrative passages chosen are so interesting and are here and there illustrated with Sanskrit parallels in such a dextrous way that one is led on by the thought-content of the passages, incidentally picking up the language with the least conscious effort. This no doubt is the correct way of introducing grammar and I should like to congratulate Mr. Biswas on his success in this difficult art.

The book is rightly dedicated to the memory of Sir Asutosh Mookerjee who has perhaps done more than any other Indian in recent years to put his countrymen abreast of others in matters of scientific research. It is also fitting that the University of Calcutta, which has done pioneering work in the furtherance of research under the inspiration of Sir Asutosh, should have come forward to make this one of its publications and thus extend its services to students of science in all Indian Universities.

S. R. RANGANATHAN.

Manufacture of Soap in India. By A. K. Menon. (*Bulletin of the Indian Industrial Research Bureau*, No. 12. Government of India Press, Simla), 1938. Pp. 63. Price Re. 1.

The Industrial Research Bureau has been publishing a number of bulletins of technical importance to Indian industries. On the subject of Indian Vegetable Oils and allied products, we had an excellent Bulletin (No. 10 of the series, by Mr. N. Brodie, M.Sc., F.C.S., A.I.C.) and we were looking forward for the logical outcome of this Bulletin, *viz.*, those dealing with the industries that utilise the oils and fats available in India. Appropriately enough the manufacture of soap in India has claimed the attention of the Bureau owing to the recent remarkable development of the soap industry in India.

Nobody could have been better placed to handle this subject in India than Mr. A. K. Menon, B.A., F.C.S., Superintendent, Kerala Soap Institute, Calicut. Few remember that Mr. A. K. Menon was a student in the famous laboratories of Dr. J. Lewokowitsch, the world renowned authority on oils, fats and waxes. This was nearly twenty-eight years ago. Since his return to India, Mr. Menon has been working continuously in Calicut in the Government Soap Factory belonging to the Government of Madras. Mr. Menon combines very happily the attributes of a research worker, a versatile professor and an able Chemical Engineer, accompanied by business acumen and enterprise. He has contributed several papers on Indian Oils and Fats; he has, since its beginning, been the Principal of the Kerala Soap Institute; and he has made a success of the Kerala Soap Institute from the business point of view. Therefore, any book on Soap-making in India from the pen of Mr. A. K. Menon will have a stamp of authority backed by unique experience.

Purely from the scientific and technical point of view, the Bulletin is a compendium of useful information to Indian Soap-makers. It is to be noted that Mr. Menon was not writing a text-book nor an exhaustive monograph on the subject from a purely scientific point of view. The Bulletin under review contains within a small compass an adequate amount of scientific, technical and business information which an industrialist in India may seek to have authoritatively for guidance before investing his money on it. There is a necessity in India to place before our political leaders, well-written, easily understandable and at the same time, scientifically accurate bulletins to supply them with a background of scientific and technical information that are necessary to guide them in their nation-building activities.

Students of General Chemistry who have no time to wade through either learned text-books or original research papers will get a bird's-eye-view of the Industry in this Bulletin which is neither too specialised nor too pedantic.

The Industrial Reserch Bureau should be congratulated on the production of this excellent Bulletin. S. G. SASTRY.

The Raman Jubilee Volume

THE November issue (Vol. 8, No. 5) of the *Proceedings of the Indian Academy of Sciences* has been published as a Jubilee Volume in commemoration of the Fiftieth Birthday of Sir C. V. Raman, and the completion of ten years of research on the Raman Effect. It is a unique publication being the first of its kind undertaken to honour an Indian Scientist, and is a great tribute to the work of this leader of scientific renaissance in India of the last quarter of a century. As indicated in the *Prefatory note to the special number,* very short notice, in fact a bare three months' time, was given to the several contributors while it is usual to plan at least a year ahead on such occasions. That in spite of this short notice there should have been such a ready and generous response from several men of science of diverse countries, which makes this volume a truly international effort, is ample testimony to the fundamental and comprehensive character of the scientific work of Sir C. V. Raman and his large school of workers.

The Raman Jubilee Volume is limited to original papers on the Raman Effect, light-scattering and related topics, being by far the best-known field of investigations of Sir C. V. Raman. The volume opens with a portrait and a brief life-sketch of the great leader of science in India. The contributions, thirty-eight in all and running over to more than 300 pages, touch upon every aspect of light-scattering and Raman Effect and indicate, as is anticipated by J. H. Hibben in his paper on *A Statistical Analysis of Trends in Research on the Raman Effect,* a wide and sustained interest in the subject in all countries, and an extensive range of problems which come within its scope.

Of the five publications on classical light-scattering, the short and suggestive paper on *Thermal Dependence of Elasticity in Solids* is contributed by Léon Brillouin. Closely related to the latter is the paper by L. Sibaiya on *Scattering of Light in a Rochelle Salt Crystal,* in which he reports the Brillouin components corresponding to the longitudinal Debye waves in this crystal and correlates the observed shifts with its elastic constants. In his paper on *Light-scattering in Anisotropic Media* Hans Mueller develops an extension of his theory of Brillouin scattering of light to optically anisotropic media and obtains remarkable confirmation of his conclusions from Krishnan's data for scattering in graphite sol under the influence of a magnetic field. R. S. Krishnan reverts to the problem of *The Anomalous Depolarisation of Light-scattering in Optical Glasses* and presents quantitative results based on photographic photometry demonstrating the existence of the *Krishnan Effect* in them. V. S. Vrkljan contributes a paper on *"Theoretische Bemerkungen Zum R. S. Krishnan's Reziprozitätsgesetz der Kolloid-Optik".*

Of the 26 papers on the Raman Effect, ten are contributed from the laboratory of K. W. F. Kohlrausch who is in no small measure responsible for the rapid progress of the subject during the past ten years. In the series of publications emerging from his school entitled *"Studien Zum Raman-Effekt",* contributions 89–95 appear in this volume. *"Mitteilung 89: Aethylenoxyd"* by K. W. F. Kohlrausch and A. W. Reitz gives the results of measurements of Raman spectrum of ethylene oxide and its polarisation characters and a detailed critical discussion of the results of various authors for ethylene oxide and cyclopropane. *"Mitteilung 90: Parasubstituiertes Acetophenon"* is by L. Kahovec and J. Wagner. *"Mitteilung 91: Asymmetrisches Phthalyl-Chlorid"* is by L. Kahovec, in which the author investigates the possibilities of attributing a C = O frequency of high value to an asymmetrical form of phthalyl chloride. In *"Mitteilung 92: Das Ramanspektrum des dimeren Ketens",* K. W. F. Kohlrausch and R. Skrabal have investigated the spectra of dimeric ketones corresponding to the diketo-form in cyclobutan-1-3-dion and found that the conclusions of the English authors regarding the existence of the dimeric ketones in monoenolic form are not supported by Raman measurements. Kohlrausch and Sabathy present the results of their investigation on the Raman spectra of *Cyclobutan-1, 2-dicarbonsaüren und Abkommlinge* in *Mitteilung 93* and O. Ballaus deals with the spectra of *Tetrolaüre und Ester* in *Mitteilung 94.* From a detailed investigation of the spectra of mononitroparaffins, especially with reference to the doubling of the line 1380, Pendl, Reitz and Sabathy (*Mitteilung 95: Stickstoffkörper XII; Nitrogruppe*)

arrive at a tentative conclusion that the nitro-group probably exists in two different forms in these compounds. Among other papers on organic compounds, S. Mizushima and Y. Morino indicate by the calculation of normal vibrations as well as by the study of isotopic effect on the *Raman Spectra and Molecular Configurations of Solid Ethylene Dihalides* that practically all the molecules in the solid state in these compounds exist in the *trans*-form. In a paper entitled *Sullo Spettro Raman Di Alcuni Idrocarburi Paraffinici* Bonino and Ansidei have studied a large number of hydrocarbons and discussed the results in relation to their chain frequencies. Murti and Seshadri have investigated the influence of solvents on the carbonyl frequency of coumarin in their paper on *Raman Effect and Chemical Constitution, Part I. Coumarin.* A critical review which will stimulate further work on the subject, is given by W. Rogie Angus in his paper on *Raman Spectra of Terpenes.*

There is a group of five interesting articles on inorganic compounds appearing in this volume. Mme. Marié Freymann and Réne Freymann have contributed a paper on *Spectres Raman et Spectres D'Absorption Infrarouge de Composés ou L'Azote est Tetracoordonné* in which they have shown that the NH frequency, like that of OH, becomes smaller and diffuse in solids and concentrated solutions of compounds in which nitrogen is tetra-co-ordinated. In the paper on *Raman Spectra of Volatile Fluorides,* D. M. Yost has calculated the force constants, entropies and heat capacities of the halides of B, P, As, C and Si and shown that the Raman spectra have proved extremely useful in solving many problems in Chemistry. In a study on the *Effet Raman et Structure des Composes AX^5: Pentachlorure de Phosphore et Homologues* Moureu, Magat and Wetroff conclude that these compounds have a pyramidal structure with a trigonal base in the liquid state, and in the solid, they have a structure AX^{4+} X^-, in which X^- plays a different role from the four other X^+. P. G. N. Nayar has given a useful *Chart of the Raman Bands of Water in Crystals* of many substances, which will be helpful in understanding the structure of bound water. The remarkable changes depending upon the influence of temperature on the vibrational and lattice Raman lines in sodium nitrate crystals form the subject-matter of a paper on the *Scattering of Light in Sodium Nitrate Crystals* by T. M. K. Nedungadi.

Another aspect of the application of the Raman spectra to the elucidation of the nature of liquid state is undertaken by B. D. Saxena in his paper on the *Depolarisation of Unmodified Light-Scattering in Liquids* and he has shown by careful experiments that contrary to the work of earlier authors, normal liquids like benzene and carbon disulphide show a definite depolarisation of the unmodified scattering. Closely related to the above subject is a paper on the *Low Frequency Raman Lines in Organic Crystals* by C. S. Venkateswaran.

An important line of work which is bound to assume great importance in future investigations is the theoretical interpretation of the Raman lines and their intensities in terms of molecular models. The increasing application of group theory to problems of this nature is brought out in a paper by Bhagavantam on the *Interpretation of Raman Spectra in Crystals: Anhydrite and Gypsum* and in another by Venkatarayudu on *Normal Frequency of the Diamond Lattice.* A different method of approach towards the same problem is adopted by O. Burkard in his paper on *Durchrechnung Einigen Ausgewählter Molekul-Modelle,* in calculating the frequencies, mode of vibration and energy distribution for the plane-vibration of valence oscillations depending on the model constants. Equally profitable is the *Relation between the Force Constant, the Inter-Nuclear Distance, and the Dissociation Energy of a Diatomic Linkage* derived by G. B. B. M. Sutherland, in interpreting the Raman measurements of simple compounds. The use of mechanical models in elucidating the vibrations of molecules is illustrated in a paper on *Eigenschwingungen Mechanischer Molekülmodelle. IV. Der Viererring* by F. Trenkler. The influence of multiple scattering of light on the intensity of the Raman lines is theoretically derived by Kastler in his paper on the *Raman Effect and Multiple Scattering of Light.*

Four papers in the volume bear on problems related to scattering of light and three on supersonics. In their paper on *Directional Variations in the Absorption and the Fluorescence of the Chrysene Molecule,* K. S. Krishnan and P. K. Seshan show

that when the incident light vibrations are along the normal to the molecular plane there is hardly any absorption and that only vibrations in the plane are absorbed. P. Jordan has contributed an interesting article *Über Biologische Wirkungen Ultraviolletter Lichtquanten,* in which he shows that a phenomenon akin to Raman effect is taking place in the interaction of light and matter in biological media. In his theoretical paper on *Some Remarks on Reciprocity,* Max Born presents in a very general form, the difficulties which theoretical physics encounters when dealing with the nature of light and ultimate particles. An attempt to examine the diminution of optical anisotropy of molecules of a liquid due to the influence of neighbouring molecules is made by B. S. Madhava Rao and K. Venkatachala Iyengar in their mathematical paper on *An Inequality Concerning Lattice Sums.* Of the three papers on supersonics, N. S. Nagendra Nath gives a theoretical treatment of the *Diffraction of Light by Supersonic Waves,* in which he points out an extreme case where one can get closed expressions for the intensities of diffraction orders. E. Hiedemann and K. Osterhammel have a paper on *Untersuchung von Schallamplituden-Feldern Mittels Einer Methode der Isochromaten,* in which a method of colour photography is described for the demonstration and the determination of energy distribution of sound field with white light. In his paper on the *Dispersion of Ultrasonic Velocity in Liquids,* R. Bär reports failure to observe any dispersion of velocities in benzene and water for a range of frequencies 7·5 and 52·5 MHZ.

The volume is priced at Rs. 6 or 10*sh.* per copy.

B. S. M.
C. S. V.

The Central Board of Irrigation in India

THE recent publication of the Central Board, *Annual Report for the year* 1936-37, not only gives the public an idea about the work that the Board is carrying on, but shows what different provinces of India are doing by way of research on problems of Irrigation. The Board provides facilities for workers from different provinces to meet together once a year and to compare notes. As its President Mr. G. M. Ross said in one of these meetings, "This annual meeting affords a splendid opportunity for Irrigation Engineers from various parts of the country who are particularly interested in research, to discuss both formally and informally, the many problems that beset irrigation engineers not only in India, but in other irrigating countries of the world. By constructive criticism of the various experiments in progress in these provinces which have Research Stations and discussion of other problems of common interest, we are afforded the best possible means of applying the combined knowledge and experience available in the country to those problems which are so important to the many million engaged in cultivation aided by irrigation. You are aware that India has a much greater area under irrigation than any other country in the world and in fact, it is equal to the total area irrigated by the next five leading countries including America".

Of the various subjects discussed in the Research Officers' meeting of the Board, the following appear to be of all-India importance:—

(1) The Role of Reservoirs in River Flood Control.

(2) Meandering of Rivers.

Discussion on these two subjects seems to have lead nowhere. It is true very little information is available about them but that is no reason why efforts should not be made to study these problems. Much of the prosperity of the country depends on flood control. During recent years we have witnessed catastrophic floods all over the country and thousands of lives and hundreds of villages have been washed. It is time that something substantial is done to increase our knowledge about these two subjects so that we can grapple the problem more effectively. A River Commission on an all-India basis is what is called for—where engineers from different provinces and a few scientists may sit together and devise means to combat the evil.

The work that is being carried out at different research stations will now be reviewed.

Punjab

In the Punjab, Irrigation Research is carried on under the direction of the Director, Irrigation Research. Besides the laboratory at Lahore, he has a River Model Laboratory at Malikpur and a number of silt laboratories at the headworks of various canal systems of the Province. The following problems appear to be of more than local interest.

It is well known that cavities do form under weirs or similar hydraulic structures and many disastrous failures had been due to these. It is a very vital problem to the irrigation authorities to prevent, if possible, or to detect the formation of such cavities below weirs. Punjab research workers seem to have been fully alive to the dangers of this problem and we find them busy with the following researches:—

1. *Design of Weirs on Sand Foundations.*—In this experiment, mathematical, experimental and field workers have combined and succeeded in replacing Bligh by a much sounder method of design. It is hoped that this method will be successful in preventing the formation of cavities below weirs. But for existing weirs it is necessary to detect defects under them.

2. *Cavities under Weirs.*—During the year under review, an investigation has been in progress to determine whether it is possible to devise a method for detecting defects and cavities under weirs. The principle employed is that wireless waves are partially reflected from any surface of discontinuity and when coming from different distances would reach an aerial in different phases. The composite reflected wave can be analysed by means of a cathode-ray oscillograph operated with a high frequency time base and from the nature of the reflection it is possible to infer defects.

3. *Effect of Silt and Temperature on Discharges.*—It is a common belief among irrigation engineers that the silt content and temperature of flowing water affect the discharge as measured by rectangular or a broad crested weir. For this purpose an experiment was set up in which the discharge in a flume was measured by current meter, a rectangular weir and by a measuring tank. It was possible to have all shades of water from clear to grey, brownish grey and then finally brown. A range of water temperature from 12° C. to 25° C. was also met with. Reynold's Number (R_e) for these experiments was above 10^5. Discharges in the rectangular weir were calculated by Rehbock's formulæ.

The experiments shewed that within the limits of experimental error variation in the temperature and silt content of the water did not produce any appreciable difference in the discharge measured by a rectangular weir and the velocity meter.

Central Station

Central Hydrodynamic Research Station at Khadakavasla near Poona

Experiments at this station had been mostly on Falls and on Rivers. Various types of falls had been tested at their station. Of these, the following are some of the well-known ones:—

1. Proportional standing wave flume meter fall with sides downstream of the fall diverging at 1 in 10, 1 in 5.

2. Proportional standing wave flume meter fall with curved divergences downstream.

3. Weir falls—free over fall type.

4. Weir falls with glacis, cistern of arrows and control blocks.

5. Weir fall with glacis, baffle, bowed cistern and deflector.

6. Notched Falls.

Notched falls (Punjab type) were more costly than any other design and also gave inferior results, so may finally be discarded.

The flume fall with friction block according to a design by Mr. Montagu was about 7 per cent. more expensive than the standard flume fall design.

The choice would then lie between a Plain Weir or a weir with downstream glacis slope and

(*a*) arrows and control blocks, or

(*b*) baffle and deflectors.

These experiments have shown that the latter are cheaper and better.

Experiments with large-scale model of the Gauges at the Hardings Bridge (the horizontal scale = 1/500) on effect of length of guide banks on flow (for the Railway Board)

The Hardings Bridge Committee at their meeting in November 1935 decided that the guide banks of the Hardings Bridge, which are 2,850 ft. long = 0·53 times the length of the bridge should ultimately be extended to 5,385 ft. the length of the bridge. The experiments were done with both Right and Left Guide Banks extended equally, Damukdia Guide Bank being removed.

The conclusion was that Sir Francis Spring's design should be adopted.

BOMBAY

This station does not now deal with hydraulic problems. It is more concerned with soil research.

1. *Soil Type in the Deccan Canal tracts and their behaviour under irrigation.*—It comprises the study of typical soil profiles, the physico-chemical changes caused by irrigation and high subsoil water levels and the reclamation of soil tilth of damaged lands after drainage.

Similar work seems to have been done at the Padigaon Sugarcane Research Station by Dr. J. K. Basu and M. S. S. Sirur.[1] It will be interesting to compare their conclusions.

UNITED PROVINCES

The following results are of more than local interest:—

1. *Treatment of canal beds with molasses.*—For staunching canal beds sugar factory bye-products were used but no successful results seem to have been obtained.

2. The correlation coefficient between the discharge of the Ganges River below the off-take of the Ganges River at Headwork and at Narora have been worked out for the month of December to May inclusive, for the years 1929–30 to 1935–36.

The conclusion stated mathematically is that if discharge of the Ganges River at Narora be taken as a function of several variables, this function is independent of discharge of the Ganges River at Hardwar in dry weather month. This conclusion seems to be surprising and requires more thorough examination.

SIND

During the current year the work of the Development and Research Division was carried out under the following heads:—

1. *Model experiments.*—Various models on regulators and falls were experimented upon.

2. *Collection of Hydraulic data on Barrage Canals.*—Out of 74 sites with discharge varying from 20 to 10,000 cu/sec. only about 22 sites had a fairly steady bed as seen from the observations of the last four years. From these 22 sites only 3 sites satisfy Lacy's two criteria, *viz.*, $P_w = 2{\cdot}67\,Q^{1/2}$ and $V = 16\sqrt[3]{R^2S}$ within 10 per cent. and as such no conclusion could be drawn from the data.

Instead of rejecting these data of 22 sites as being untrustworthy because they do not satisfy Lacy's equation, it would have served the cause of science better if Sind had tried to develop their own relations from them.

No new station has been opened in any other provinces since the last report of 1935–36 was out. It is time that provinces like Bengal, Bihar, Orissa and Madras should have their own stations. If they cannot afford to have a separate station each, Bengal, Bihar and Orissa whose problems are more allied in nature and interconnected, may have a common research station at a central place.

[1] See "Soils of the Deccan Canals—I. Genetic Soil Survey and Soil Classification. Nira Right Bank and Prarara Canals", *Indian Journal of Agricultural Science*, Oct. 1938, **8**, Part V.

INDUSTRIAL SECTION

Power Alcohol in India

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Introduction

THE problem of using alcohol as liquid fuel in internal combustion engines has long been engaging the attention of the people in India, and as far back as 1918, the Indian Industrial Commission, under the Chairmanship of Sir Thomas Holland, made recommendations regarding power alcohol in the following words:—

"On several occasions our attention was drawn to the possibility of making industrial alcohol from hitherto neglected vegetable materials, some of which appear to be sufficiently promising to justify investigation and experiment. We recommend that a more liberal policy should be followed by the excise authorities in respect of the class of denaturant prescribed, and more regard might be paid to the likelihood rather than to the mere possibility of frauds to the revenue, when the requirements of the commercial users conflict with excise regulations."

In pursuance of the above recommendation, the Government of India passed a resolution on October 1, 1927, to the effect that power alcohol should not be handicapped by the imposition of any excise duty except such as should be leviable upon any fuel adjunct which is separately liable to duty. It may therefore be concluded that the desirability of encouraging the use of power alcohol in the form of alcohol-petrol mixed fuel had been recognised by the Government even at a time when the entire production of molasses in India was being otherwise consumed, and there was no likelihood of any surplus quantity becoming available in the near future for the manufacture of power alcohol.

Availability of Raw Material.

Alcohol is essentially an agricultural product, as it can be manufactured from potatoes, beet, cereals, molasses, etc.; in fact from any product containing sugar and starch. Thus, potato forms the chief raw material for alcohol in Germany, beet and molasses in France and Czechoslovakia, maize in U.S.A., and molasses in almost every country. India is therefore most favourably situated so far as the availability of the raw materials is concerned, for, in addition to an inexhaustible supply of cheap cereals, molasses are now available in the country at a nominal cost to the extent of about 200,000 tons per year. Indeed, the disposal of this surplus quantity of molasses, for which at present there is no market, is one of the acute problems in the sugar industry and strangely enough, it is this problem which has brought into prominence the question of power alcohol manufacture in India.

The following table gives the figures for the production of molasses by central factories working with cane:—

Production of Molasses by Central Factories Working with Cane

	1937–38 tons	1936–37 tons	1935–36 tons	1934–35 tons	1933–34 tons	1932–33 tons
U.P.	215,700	207,900	182,600	125,500	110,052	64,600
Bihar	80,800	133,700	97,200	71,900	61,000	57,900
All India ..	364,000	414,600	337,100	233,900	190,400	130,400

It is therefore estimated that some 12 million gallons of power alcohol can at once be produced from surplus molasses, without reckoning into account the quantity that may become available with the progress of prohibition in the country and the better marshalling of such resources as mohua flowers, cane tops, etc.

At one time, hopes were entertained that a substantial quantity of molasses would be exported out of the country, but the working

of a number of years has shown that in spite of substantial facilities given, the export scheme has been a virtual failure. The average price for molasses received by the sugar factories was about anna 1 and pies 2 only per maund, while even at this price, the exporting company declared the value of molasses on board the ship at Calcutta to be annas 7–11 per maund. It is understood that some of the distilleries favourably situated in the cane factory areas in the U.P. and Bihar have contracted for the supply of molasses at annas 2 per maund delivered at the distillery, while annas 4 per maund will be considered quite a satisfactory price by the sugar factories.

Method of Manufacture of Alcohol

Alcohol is manufactured by the rectification of the dilute solution obtained after the fermentation of sugar- or starch-bearing materials is complete. The usual strength of this fermented wash, as it is generally called, is about 6–8 per cent. Due to certain peculiar properties of a solution of about 96 parts by volume of alcohol and 4 parts of water, this is the maximum strength of alcohol that can be obtained by straight rectification of the 'fermented wash'.

The manufacture of industrial alcohol is, at present, being carried out in all distilleries in India equipped with patent continuous stills. In fact, the alcohol as it comes out of these stills, is what is known as 'rectified spirit' and the strength varies generally from 90 per cent. to 96 per cent. by volume. The subsequent manipulation of this spirit in warehouses by the addition of water, chemicals, or other substances, converts it into various forms of drinking spirit, 'methylated spirit', or 'specially denatured spirit'.

Further dehydration of rectified spirit was till recently a matter of considerable difficulty, and the usual process of getting 'absolute alcohol' was by distillation with lime. This was a costly process and entailed considerable losses in working. But within the last fifteen years or so, at least two different processes have been developed and have met with considerable commercial success. These are commonly known as the azeotropic process and the salt-dehydration process. The following table (*International Sugar Journal*, March 1938) gives the present annual production of absolute alcohol by these processes:—

World Production of Absolute Alcohol (1937)

I. Azeotropic Process

	Hectolitres*
(*a*) Melle system ..	5,250,000
(*b*) 'Drawinol' system ..	3,000,000
Total ..	8,250,000

II. Salt-Dehydration & Other Processes

	Hectolitres
(*a*) Hiag system (alkali acetates) ..	3,975,000
(*b*) I.G.F. system (gypsum)	265,000
(*c*) Merck Pressure system (lime) ..	120,000
Total ..	4,360,000

Importance of Commercial Dehydrated Alcohol

It may well be asked what was the necessity for the commercial manufacture of cheap dehydrated alcohol. The reason is, that dehydrated alcohol has a much wider range of miscibility with petrol than rectified spirit, which is found to be unsuited for the preparation of alcohol-petrol mixtures, in the proportions in which such mixtures were found to be suitable as motor car fuel. Mixtures of rectified spirit with petrol tend to separate easily. On the contrary, mixtures made with dehydrated alcohol and petrol have been found to be stable and perfectly satisfactory for all practical purposes.

As dehydrated alcohol is now almost exclusively used for the generation of power and as recent researches have evolved processes so that now there is little difference between the cost of manufacture of dehydrated alcohol and rectified spirit, 'power alcohol' has now become almost synonymous with dehydrated alcohol. It seems, therefore, that for power purposes the use of denatured rectified spirit of about 90 per cent. strength is an anachronism and should be given up.

Cost of Manufacture of Absolute Alcohol (power alcohol).—The estimated cost of manufacture of power alcohol (absolute strength) prepared directly from fermented wash by the fourth technique of Usines de

* Hectolitre = 22 gallons.

Melle azeotropic process, and for a plant of about 1,550 gallons per day are given below:

		Per gallon Pies
1.	Cost of steam (32.5 lbs. at 0.22 pie per lb.)	7.15
2.	Cost of cooling water, power, light, etc.	0.84
3.	Cost of chemicals (Acid, nutrients for yeast, etc.)	3.00
4.	Cost of entraining liquid for dehydration (0.00045 gallon at Rs. 3–4 per gallon)	0.28
5.	Cost of alcohol lost in dehydration (0.15% at As. 4–6 per gallon)	0.08
6.	Wages of labour and staff	7.60
7.	Cost of management	3.10
8.	Licence fee for the patent rights	0.20
9.	Depreciation charges	10.70
10.	Warehouse charges	1.80
	TOTAL (excluding cost of molasses)	34.75

It is therefore possible to manufacture power alcohol in the U.P. and Bihar sugar factory areas, in central distilleries at a cost of about annas 4–6 per gallon, after paying for molasses at annas 4 per maund delivered at the distillery.

Alcohol Fuels Suitable for Motor Cars.—It has now been established beyond dispute, both by careful bench experiments and long usage amongst the public, that mixtures of petrol and absolute alcohol within certain definite proportions are just as satisfactory fuels, if not better, as straight petrol. The optimum proportion of alcohol in the mixture would naturally depend upon the quality of the petrol, the make of the engine, the average atmospheric conditions of the country where the fuel is used, and similar other considerations. However, there is general agreement that fuels containing high portions of alcohol (25 parts in 100 parts of mixed fuel) and likely to give some trouble when used in cold countries would be found quite satisfactory in tropical countries like India.

ALCOHOL FUELS AND POWER DEVELOPMENT

Heat Value of Combustible Mixtures in the Engine and Power Output.—Pye, in his *Internal Combustion Engine* (1931, p. 54), has shown that the calculated power of an engine would be proportional to the heat generated per standard cubic foot of the mixture sucked into the cylinder, multiplied by the volume ratio on combustion, which is the ratio of the number of molecules of the various products of combustion to those of the combustible mixture. This may be regarded as potential source of increased power from an engine; the higher the ratio, the greater the assessment of the value of the mixture as a working substance.

By way of illustration, we may take the cases of heptane, C_7H_{16} of calorific value 10,700 C.H.U. per lb. and ethyl alcohol, C_2H_5OH, of 6,540 C.H.U. per lb. The combustion of the correct fuel-air mixtures, together with the heat generated, are as follows:—

(i) $2\ C_7H_{16} + 22\ O_2 + 82{\cdot}8\ N_2 = 14\ CO_2 + 16\ H_2O + 82{\cdot}8\ N_2 + 2{\cdot}155 \times 10^6$ C.H.U.

(ii) $2\ C_2H_6O + 6\ O_2 + 22{\cdot}6\ N_2 = 6\ H_2O + 4\ CO_2 + 22{\cdot}6\ N_2 + 0{\cdot}605 \times 10^6$ C.H.U.

Hence, the quantities of heat generated per mol of the fuel-air mixtures are:—

(i) For heptane:—

$$\frac{2{\cdot}155 \times 10^6}{106{\cdot}8} = 20{,}180 \text{ C.H.U.}$$

(ii) For alcohol:—

$$\frac{0{\cdot}605 \times 10^6}{30{\cdot}6} = 19{,}750 \text{ C.H.U.}$$

Taking into consideration the volume ratio of the products of combustion to the initial gas mixtures, the total energy of the fuel-air mixtures would be:—

(i) For Heptane, with a volume ratio of $\frac{112{\cdot}8}{106{\cdot}8}$ or 1·056:—

$$20{\cdot}108 \times 1{\cdot}056 \times \frac{1{\cdot}400}{359} = 83{,}100 \text{ ft.-lb.}$$

per standard cubic foot.

(ii) For Ethyl alcohol, with a volume ratio of $\frac{32{\cdot}6}{30{\cdot}6}$ or 1·065:—

$$19{,}750 \times 1{\cdot}065 \times \frac{1400}{359} = 82{,}200 \text{ ft.-lb.}$$

per standard cubic foot.

It would thus be seen that even though the calorific value of a substance is considerably lower than that of another, the correct combustible fuel-air mixture may have practically equal energy content on account of a smaller proportion of air

required for combustion and consequently lesser dilution with the inert nitrogen. It is rather interesting to find that in the case of all the more common liquid fuels, the energy content of a correct mixture is almost identical, as shown in the following table compiled by Ricardo:—

Substance	Specific Gravity at 15° C.	Lower Calorific value in C.H.U.		Latent Heat of evaporation C.H.U. per lb.	Ratio by weight in correct mixture	Volume ratio on combustion	Heat liberated per S.C.F. of correct mixture C.H.U.	Total energy per S.C.F. of correct mixture C.H.U.
		per lb.	per gallon					
Petrol	0·76	10,430	79,200	73	14·6	1·047	57·0	59·7
Heptane (97 per cent.) ..	0·69	10,700	73,900	75	15·1	1·056	56·9	60·1
Benzol	0·88	9,640	85,200	95	13·2	1·013	57·6	58·4
Ethyl Alcohol (pure) ..	0·79	6,540	51,800	220	8·97	1·065	56·6	60·3
Rectified Spirit (95 per cent.) ..	0·815	6,040	48,900	246	8·4	1·065	54·5	58·0

Power Development in Motors

The development of power in motors depends a good deal upon the construction and working of the carburettor. The work of Ricardo, Hubendick and others has established the following facts and general relationships:—

(1) With most fuels, starting with low revolution speeds, the power developed at first rises quickly, reaches a maximum, and then falls down when the rate of revolution is still further increased.

(2) The maximum power is developed when the ratio of fuel to air is higher (4–6 per cent.) than that necessary for complete combustion.

(3) The maximum efficiency is obtained when the ratio of fuel to air is lower (about 4 per cent.) than the correct mixture.

(4) With alcohol the increase in power is very marked—much more than with petrol —amounting to nearly 10 per cent. with very rich mixtures.

(5) For smoothness and flexibility in running, multi-cylinder engines must be fed with mixtures slightly on the over-rich side.

Comparison of the Properties of Petrol and Alcohol-Petrol Mixed Fuel in Motor Car Engines.—Prof. Hubendick contributed a paper to the World Power Conference, London, 1928, on the 'Use of Ethyl Alcohol as Motor Fuel' (*Transactions*, 3, 724–48), based on the results of an exhaustive series of comparative experiments with petrol and petrol mixed with varying amounts of alcohol. For each mixture, the effect and the consumption of fuel per horse-power-hour for different sizes of the carburettor jet were registered graphically. The following is a summarised extract of a part of his paper:—

"Series of experiments were carried out with undiluted gasoline and with gasoline mixed with 10, 15, 20, 25 per cent., etc., of alcohol; for each type of fuel, tests were made with different sizes of carburettor jets. The series of graphs obtained in this manner is very instructive. It shows that, with a minimum fuel consumption, the results of the experiments with undiluted gasoline and with gasoline containing 10, 15 and 20 per cent. of alcohol very nearly coincide. In reality, the heat consumption decreases slightly within the above limits, as the percentage of alcohol in the fuel increases, although the difference is very small. Hence in the case of a carburettor adjusted for use with gasoline, not more than 23 per cent. of alcohol must be present in the gasoline-alcohol mixture, if good results are to be obtained. This fact can be explained by assuming that the characteristic properties of the alcohol, do not exert themselves appreciably until the proportion of the alcohol has increased to 23 per cent. If the percentage of alcohol be still further increased, the physical properties of the alcohol commence to exert their influence, and it becomes necessary to readjust the carburettor. It may be mentioned that the results given above do not refer to those obtained on one engine only, but are entirely consistent with results obtained with different types of motors, showing only slight variations in actual quantities.

"Summarising, it has been shown that gasoline can be mixed with alcohol in such proportions that the mixture contains upto 25 per cent. of alcohol without this proving

detrimental to its use as fuel for petrol engines. It is therefore possible to use such a mixture in these engines without taking special precautions, and to obtain with it results as good as those obtained when using gasoline. To verify this statement, tests have been made in automobile engines of different makes and running under climatic conditions unfavourable for the use of alcohol mixture, that is, at a low air temperature. These experiments have shown that the engine runs as well on such a mixture as it does on gasoline alone, and that the driver has been unable to say which fuel was being used."

Experiments performed by Lichty and Phelps at the Yale University, and published in the *Industrial and Engineering Chemistry*, February 1938, confirm in a general way these results obtained by Prof. Hubendick. They write as follows:—

"Applying the multicylinder power and fuel consumption data to motor vehicles on the highway, and using air-fuel ratios equal to or richer than maximum power for gasoline and without adjustment of air-fuel ratio on substitution of the 10 and 20 per cent. blends, a decrease in volumetric fuel consumption of about 2 and 3 per cent. for the 10 and 20 per cent. blends respectively, should be obtained."

The following table gives the results of the experiments:—

Comparative Road Tests with Petrol and Alcohol-Petrol Mixed Fuels

The only carefully conducted experiment done in India was by Mr. J. Charlton, Agricultural Chemist to Government of Burma (now Director of Agriculture). The following is extracted from the *Agricultural Survey Bulletin No. 24 of 1936*, Department of Agriculture, Burma:—

"Absolute alcohol-petrol fuels not being available in Burma, in January 1935 the writer prepared such mixture on a small scale in the laboratory and tested them in a 20.9 H.P. car using a special small tank, so that consumption could be accurately recorded. The carburettor had been previously adjusted for economy and was not altered in any way for the tests. A circular course of approximately eight miles was arranged to minimise wind resistance effects and as far as possible a steady speed of 25 m.p.h. was maintained. Results were as follows:—

	Miles per gallon	Equivalent to
(1) Burma Oil Company Petrol (Pump) ..	21.13	100
(2) 15 : 85 mixture ..	22.50	101.5
(3) 25 : 75 mixture ..	22.73	107.6

Maximum speed was in all cases 57 m.p.h. and no difference could be distinguished in

Brake Thermal Efficiencies (in per cent.) at Comparable Conditions.

Fuel	Maximum Power			Richest complete combustion		
	1,000 r.p.m.	2,000 r.p.m.	3,000 r.p.m.	1,000 r.p.m.	2,000 r.p.m.	3,000 r.p.m.
			Full Load			
Gasoline	20·3	21·4	19·6	22·8	24·0	22·0
10 per cent. Blend	20·7	21·2	19·7	23·2	24·4	21·5
20 per cent. Blend	21·4	22·0	20·0	24·0	24·8	22·2
			Two-thirds Load			
Gasoline	18·0	18·7	17·4	22·2	21·2	19·0
10 per cent. Blend	18·8	18·8	16·9	21·6	21·2	18·8
20 per cent. Blend	19·5	19·0	17·4	21·8	20·5	19·2
			One-third Load			
Gasoline	14·1	14·1	12·4	15·9	14·2	..
10 per cent. Blend	14·0	13·9	12·3	16·1	13·3	..
20 per cent. Blend	14·4	13·9	12·6	15·0	14·2	..

acceleration from 10–30 m.p.h. Speed and acceleration tests were mean results obtained by running in opposite directions. It was noticed that with the 25 : 75 mixture it was impossible to make the engine pink (detonation); the 15 : 85 mixture was almost free from tendency to pink while using petrol alone careless opening of the throttle caused severe pinking. The car had done a considerable mileage at the time of the test and was in need of decarbonisation and valve grinding. The greater economy of the alcohol-petrol mixtures was beyond all doubt and driving was very much simplified since pinking disappeared."

Excise Duty and Power Alcohol.—Under the new Government of India Act of 1935, the revenue from excise duty on petrol and on alcohol destined for power or industrial purposes goes to the Central Government, who at present are firm in their decision to levy the full amount of excise duty on power alcohol as on petrol. The Provincial Governments which are vitally interested in the development of the alcohol industry are therefore confronted with this serious question of competing with imported petrol *on equal terms*—a situation which is unique in the world history of power alcohol. However the recent decision of the Federal Court of India regarding the powers of the Provincial Legislature to impose a sales tax on motor spirits may help the cause of power alcohol in those provinces which are vitally interested in the question of finding an important and economically sound outlet for surplus molasses.

Conclusion

Some interesting information regarding power alcohol and its use in other countries are given below:—

1. *Comparative Prices of Power Alcohol in Various Countries in 1936*

(Tokayer, *World Petroleum*, June 7, 1936)

Country	Price of Power Alcohol per gallon	
	In American Cents	Equivalent in Indian Currency
		Rs. A. P.
1. Austria	57	1 10 3
2. Czechoslovakia ..	76	2 3 0
3. France	27	0 12 6
4. Germany ..	76	2 3 0
5. Hungary ..	79	2 4 4
6. Italy	88	2 8 6
7. Jugoslavia ..	40	1 2 5
8. Latvia	59	1 11 2
9. Poland	19	0 8 9
10. Spain	52	1 7 11
11. Sweden	31	0 14 3

2. *Consumption of Power Alcohol in Various Countries*

(*Ind. & Eng. Chem.*, News Edition, July 20, 1936)

Country	Year	Quantity in Imperial gallons	Remarks
1. Austria ..	1934	1,018,000	
2. Brazil ..	1935	10,455,000	65,472,780 in 1936
3. Cuba ..	1934	2,367,000	
4. Czechoslovakia ..	1934	13,190,000	
5. France ..	1934–35	81,524,000	
6. Germany ..	1936–37	40,121,000	
7. Hungary ..	1934	2,106,000	
8. Italy ..	1934	1,402,000	Rapid increase since 1934
9. Latvia ..	1934	1,350,000	
10. Poland ..	1934	1,700,000	
11. Spain ..	1935	2,400,000	
12. Sweden ..	1934	2,400,000	
13. United Kindgom	1935	1,242,000	

3. *Power Alcohol Plants Installed in Various Countries*

Country	Azeotropic Process*		Salt-Dehydration Process†	
	No.	Capacity per day	No.	Capacity per day
		(In Hectolitres)		(In Hectolitres)
1. Argentine ..	1	300	..	..
2. Australia ..	1	150	..	..
3. Austria ..	1	220	..	..
4. Belgium ..	3	400	..	..
5. Bulgaria ..	..	..	2	180
6. Brazil ..	13	2,750	3	190
7. Chili ..	2	120	..	..
8. Columbia ..	..	..	2	60
9. Czechoslovakia ..	24	3,236	14	1,360
10. Denmark ..	1	40	..	..
11. England ..	3	580	..	..
12. France ..	45	14,535	2	1,200
13. ,, Colonies ..	5	430	..	..
14. Germany ..	10	3,900	1	300
15. Holland ..	1	3	..	..
16. Hungary ..	6	700	..	..
17. Irish Free State	5	150	..	..
18. Italy ..	14	3,455	1	40
19. Lettonia ..	2	440	..	..
20. Lithuania ..	1	75	..	..
21. Panama ..	1	40	..	..
22. Poland ..	3	530	..	..
23. Portugal ..	1	60	..	..
24. South Africa ..	3	360	1	60
25. Spain ..	1	30	4	900
26. Sweden ..	1	30	2	180
27. Yugoslavia ..	5	425	2	280
Total ..	153	32,959	34	4,750

* Information available upto the end of 1936,
† Information available upto 1935,

4. *Alcohol-Petrol Mixed Fuels in Different Countries*

Country	Commercial name of the mixed fuel	Composition			Whether alcohol mixing is compulsory
		Petrol	Benzol	Alcohol	
1. Austria	..	..	80–60	20–40	Yes.
2. Australia ..	Shellkol	85	..	15	No.
3. Brazil	..	..	..	..	Yes.
4. Bulgaria	..	75–70	..	25–30	Law not enforced.
5. Chili	..	..	..	..	Yes.
6. Cuba	Mofuco	37	3	60	No, but favourable.
7. Czechoslovakia ..	Dynalkol (i)	80	..	20	..
	(ii)	70	4	26	Yes.
8. Denmark	..	75	..	25	No, but State monopoly.
9. England	Cleveland Discol	70	15	15	No, but favourable.
10. Equador	..	80	..	20	Yes.
11. France	..	Various Proportions			Yes, State monopoly.
12. Germany	Monopoline	Various Proportions			Yes, State monopoly.
13. Hungary	Motalko	80–70	..	20–30	Yes.
14. Italy	..	80	..	20	Yes.
15. Lettonia	Latol (i)	50	..	50*	
	(ii)	67	..	33†	Yes, State monopoly.
16. Lithuania	Motorin	75	..	25	Yes.
17. Natal	Natalite	50	..	50	No, but favourable.
18. Panama	..	80	..	20	No, but favourable.
19. Philippines ..	Gasenol	70	..	30	..
20. Poland	(i)	85–70	..	15–30‡	..
	(ii)	15–30	..	85–70§	No, State monopoly.
21. Sweden	Lattbentyl	75	..	25	No, but favourable.
22. Yugoslavia ..	..	80	..	20	Legislation favourable.

* Summer Time Mixture.
† Winter Time Mixture.
‡ For Motor Cars.
§ For Tractors.

Ragi, *Eleucine coracana* Gaertn.,—A New Raw Material for the Malting Industry

BARLEY, *Hordeum sativum*, occupies the pride of place among the cereals as raw material *par excellence* for malting both in the brewing and the food industries. Attempts have been made, from time to time, to employ other cereals, wheat, rye, rice, etc., but none of these has, to any serious extent, affected the pre-eminent position occupied by barley.

While it is possible that there are sound reasons for its continued employment in a highly specialised field such as the brewing industry, the possibility of substituting or supplementing barley in the food and pharmaceutical industries deserves careful consideration. This problem is of particular interest to India where barley is by no means an extensive crop, only a little over 6 million acres, confined to four provinces (United Provinces, Bihar, Orissa and the Punjab) in North India, being under cultivation. Barley is not cultivated in South India except, perhaps, for a small tract in the Nilgiris. The three principal millets of India, *viz.*, *cholam* (*Andropogon sorghum* Brot.), *bajra* (*Pennisetum typhoideum* Rich.) and *ragi* (*Eleucine corcana* Gaertn.), together occupy over 57 million acres, and any possibility of employing these starchy food grains in the malting industry demands special consideration. India imports, annually, over Rs. 24 lakhs worth of farinaceous and invalid foods of which malt is the primary constituent, and for these reasons, investigations on the malting of the more abundantly available cereals is of interest to India, in general, and to South India, where barley is not cultivated, in particular.

Work in this field was first started in the Agricultural Research Institute, Coimbatore, in 1917. At the Madras Exhibition, 1917, the Government Agricultural Chemist exhibited a number of malted foods, containing the malts prepared from *cholam* and *ragi* as the essential ingredients.[1] Investigations relating to malting have continued to occupy the attention of the Agricultural Research Institute, Coimbatore, ever since.

The relative merits of *cholam*, *bajra*, *ragi* and other locally available millets were examined by Viswanath, Rao and Ayyangar,[2] who reported that while both *cholam* and *ragi* could be adapted for malting, the former is to be preferred in view of the bigger size of the grain and the absence of any tendency to felt in the malting tray.

Investigations relating to the chemical examination of Indian foodstuffs were initiated by Prof. Roland V. Norris, at the Indian Institute of Science, Bangalore, in 1925. The work was carried out under two main lines, (1) the isolation, analysis and biological assay of the proteins of the foodstuffs, and (2) the study of the enzymes of the resting and germinated materials. The studies revealed that *ragi* contained a prolamin of high biological value[3] and that germination led to the production of a highly active diastase, more potent than that from *cholam*. These two observations prompted the Institute workers to re-examine the malting qualities of *ragi* with a view to manufacture from it a satisfactory malt extract suitable for employment in the food and pharmaceutical industries.

Eleucine coracana, ragi, is an extensively cultivated millet occupying over 7 million acres, of which nearly 72 per cent. lies in Madras and Mysore. It is the premier crop of the Mysore State, and is perhaps the cheapest food grain on the market, with a traditional reputation as a nutritious and sustaining food. A variety of *eleucine* is cultivated in Africa and feeding experiments conducted by Orrù[4] have shown that rats, maintained exclusively on a diet of *eleucine*, kept in good condition and showed a considerable increase in weight (209 per cent. average increase in 65 days). Camis[5] studied the vitamin content of *Eleucine coracana* and records that pigeons fed on

[1] Sivan, *The Agric. J. India*, 1919, **14**, 71.

[2] Viswanath, Rao and Ayyangar, *Mem. Dep. Agr. Indic, Chem. Ser.*, 1918, **5**, 117.

[3] Nfvogi, Narayana and Desai, *Ind. J. Med. Res.*, 1934, **22**, 373.

[4] Orrù, *C. A.*, 1929, **23**, 3753.

[5] Camis, *Ibid.*, 1935, **28**, 6781.

vitamin B_1-free diet recovered in 2–5 days after feeding on *ragi*. Luigi Massa[6] mentions that *E. coracana* is employed for preparing a fermented liquor, similar to beer, in Africa. The protein of *ragi* contains phosphorus, and recent work[7] at the Nutrition Research Laboratory, Coonoor, has shown that among the cereal proteins, the one from *ragi* is the best for the maintenance of the adult rat.

From what has been said above, it will be seen that the merits of *ragi* as a raw material for malting, assert themselves for consideration, and the work carried out at the Institute, which has now reached a successful stage, was directed to a study of the conditions necessary for obtaining maximum transformation during the malting of the grain.

The sequence of operations leading to the production of malt runs as follows:—40 hours steeping, flooring for 5–6 days, controlled kilning for 24 hours and final curing at 95° C. for 30 minutes. The resulting malt has an extremely agreeable aroma, yields 74 per cent. extract and possesses good keeping qualities.

The smallness of the grain necessitates a thick spread (3″) of the grain with frequent ploughing to ensure evenness of germination. Drum germination gives better results. Under these conditions there is no tendency to felt and a uniformly germinated product results. The smallness of the grain is a decided advantage in kilning, tending not only to minimise fuel costs but also ensuring uniform drying. Under properly controlled conditions, the malting loss does not exceed 15 per cent.

Malt products.—Extract. Conditions for preparing malt extract have been worked out. Best results are obtained by percolation at 70° C. with water added in proportion of 1 part of broken malted grain to 8 parts of water. Final filtration in a Seitz filter gives a water-clear extract containing nearly 10 per cent. total solids. Several semi-commercial-scale trials have been successfully conducted in the Department. More recently, concentration of one batch of malt liquor has been carried out in Scott's patent Forced Circulation Evaporator, which was made available to us through the kind courtesy of the Government Industrial and Testing Laboratory, Bangalore. A clear, honey-coloured product, ref. index 1·4906 at 25° C., and Sp. Gr. 1·40 at 25° C. was obtained.

The nitrogen content of the extract was found to be 3·5 per cent., somewhat below the specification given in the *British Pharmacopœia*. This is due to the fact that *ragi* (H. 22) employed for this work is poor in nitrogen. A number of varieties of *ragi*, obtained through the kind courtesy of Rao Bahadur G. N. Rangaswami Ayyangar, Millet Specialist, Government of Madras, have since been examined for their nitrogen content, and two varieties, E.C. 1540 and E.C. 2928, with nitrogen contents of 2·27 and 1·83 respectively, have been selected for malting trials. It is pertinent to point out that both these varieties are white, and possess good malting qualities.

I should like to associate with this investigation, the names of Messrs. N. Narayana, A. Krishnamurthy and more recently Mr. S. Srinivasa Rao. Special mention, however, must be made of Mr. A. Krishnamurthy, who was largely responsible for determining the optimum conditions for malting. A variety of invalid and "vitaminised" malt foods were exhibited at the Mysore Dasara Exhibition, 1935. These researches would not have reached the present stage, but for the enthusiastic co-operation of Mr. M. Sreenivasaya, the keen interest evinced by Sir C. V. Raman, and the kind and continued encouragement of Rao Bahadur B. Venkatesachar.

B. N. Sastri.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.

[6] Massa, *Ibid.*, 1935, **29**, 6959.
[7] Swaminathan, *Ind. J. Med. Res.*, 1938, **26**, 113.

Some Aspects of the Indian Sugar Industry*

By C. J. H. Penning, M.Am.Soc.Mech.E.
(General Manager, Mysore Sugar Co., Ltd.)

THE development of the modern Indian Sugar Industry has been spectacular. It has been my privilege to be closely connected with similar rapid development and modernisation of an indigenous sugar industry in the Philippines and in South China, but the development in India has been unique in many respects.

To begin with, many laymen have contributed to this progress and in spite of this, the industry in India has reached a very creditable grade of efficiency in a comparatively short time.

A young industry like the Indian sugar enterprise will naturally be compared with similar and older industries elsewhere. Indeed, severe criticism has been launched against the Indian industry, especially by sugar interests in Java. A leading article in a Dutch newspaper was headed "Protection produced deception". The writer bitterly ruminates on the loss of the Java sugar export trade to India, which at its optimum exceeded 10,00,000 tons annually. This has now been reduced to about a tenth of this, and the decline is continuing. The article alleged, amongst other things, that the Indian industry, through protection, had grown far too quickly; that a large amount of capital had been invested without adequate returns and that investors blamed the Government and demanded more and yet more protection. However, the facts and expectations of the first Tariff-Board, embodied in their report were as follows:—

(1) That the price of imported Java sugar would drop to Rs. 4 per maund and, perhaps, to Rs. 3–4 per maund.

(2) That in case the price of Java sugar should drop below Rs. 4 per maund, the duty should be increased by 8 annas.

(3) That the reasonable sales price of Indian sugar during the period of protection, should be Rs. 8–13–0 per maund.

(4) That the average recovery of Indian factories at the end of the period of protection would be 9·4%.

The protection given to the sugar industry in India, was principally aimed at betterment of the cultivators' conditions. This is very obvious, because as soon as the new mill-owners were reaping large profits under cover of the protective tariff and low cane prices, the Government of India nearly killed the industry, first by levying an exorbitant excise duty and later by regulating the cane prices. The excise duty was, in my opinion, indefensible, but it was the easiest way for the Government to collect some of the large sums of money which remained in the country as a result of the development of this modern industry. Many profited; cane growers, jute and cotton mill-owners, railways, machinery and other suppliers, fuel merchants, wholesalers and retailers in the sugar trade, but for the Government the easiest way to collect was at the source. This was undoubtedly unjust to the many people who had invested money in this industry on the promise of good returns for several years from a protected industry. Even before any reserves could have been set aside or plant properly depreciated, the excise duty absorbed all of the profits of the smaller factories. And, the average size of the Indian factories *was* small, very much smaller than the factories erected in the Philippines where the industry turned in a few years from small muscovido plants (gur plants) to the manufacture of cargo sugar (96 Pol.) by large central factories. The question of the minimum size of an economic plant thus became important and after considerable discussion a 400-ton unit was decided for Mysore. And, when I came to Mysore to build this 400-ton plant, I saw the possibilities of rapid expansion necessary for ultimate financial success. The yard and mill site were therefore planned from the start for 1,200 tons and the first extension to 800 tons was ordered as soon as the 400-ton plant was in operation. Had this not been done, with the consequent annual increase in yield from about 5,000 tons of sugar to over 8,000 tons in the second year, the Company would not have made any profit at all for the second year, because the excise duty paid during the second year was exactly the amount of nett profits made during the first year. Other owners also soon realised that the 400-tons unit was no longer economical, if a Rs. 40 excise duty had to be paid, with the result that factories with the necessary finance rapidly increased their daily crushing capacity.

Various critics have pointed out that both cane production and sugar content of the cane are much higher in Java, the Hawaian Islands and Mauritius, than in India. Such comparisons are not fair because of climatic variations, soil differences, irrigation facilities and also because of the methods of cultivation which are much better, being closely controlled by the factories who cultivate their own cane. Canes in these countries are cut as near as possible to maturity and are milled inside 24 hours after being cut and properly topped. With such raw material, it is easy to get 2% more sugar of higher purity than under the conditions prevailing in India, where cane is purchased from ryots who have neither the knowledge nor facilities or desire for intensive cultivation. Canes are cut days ahead, then transported to the mills over long distances; after arrival at the weighbridges, there is, sometimes, still further delay.

* A lecture delivered under the auspices of the South Indian Science Association, Bangalore, on the 16th December 1938.

Cane is a perishable product and no time should be lost in milling the cane as soon as possible, after it has been cut.

Now, with the cheap and very reliable motor lorries available, transport by motor lorries is quite a paying proposition.

In Mysore, the Sugar Company, assisted by the Government, embarked on a programme of building feeder roads from villages to existing main roads and improving main roads. Weighbridges located at strategic points, have reduced the maximum ox-cart haulage to seven miles.

From these yards, motor lorries and lorries with trailers move the cane in the shortest possible time to the Factory.

The ryot in India is paid by weight for his cane and, therefore, collects everything growing in his field including secondary and tertiary growths, badly grown cane, damaged stalks, diseased canes, and as much top as he thinks he can get away with. It is a battle of wits, the buyer making deductions for poor cane, the ryot trying to deliver the last scrap of cane from his field.

In Mysore State, conditions are very much better, because the ryots get instructions in the cultivation and husbandry of cane, have irrigation, are advanced fertilisers and agricultural implements, whilst the crop is controlled by Inspectors in the field who give only permission to cut down when the cane is as near as possible at its best.

Cane production in India varies from 10 tons to 62 tons per acre and whilst well-cultivated canes have a sugar content of 18% or even higher, we are glad if the average percentage of the cane milled reaches 14% whilst it is sometimes below 10%.

Furthermore, cane is bought in India as early as possible and as late as possible, as long as the recovery still allows a margin of profit.

In Java, the capacity of a factory is adjusted to the area on which the factory grows its cane and if at all it is possible, all the cane is milled inside 100 days and as near to maturity as possible. Bad canes, if there be any such, are left in the fields, canes are topped way down (tops are used for seed) and the cane milled as soon as possible after cutting. With similar raw material, the factory results in India would be as good, if not better, than in Java. Specially because the Indian factories being newer, are modern, which cannot be said of all Java factories, where fixed mills, old fashioned heaters and evaporators, double subsiding and primitive handling of mud, can still be found in several factories.

Conditions in the Philippines are also strictly not comparable with those in India. The erection of the large central factories in the Philippines was mostly undertaken by concerns already owning large sugar properties elsewhere. The size of the factories was large and they were built and operated by experts. Also the Filipino planter is a man of substance, cultivating hundreds of acres instead of one, with modern cultivation implements and as much fertiliser as he can economically use. Moreover, he is not paid in cash, but receives his share of the sugar actually obtained from his cane, so that he is very much interested in supplying the best cane he can.

A planter who brings bad cane to the mill would soon be unpopular with the other planters.

In the Hawaian Islands, the care given in order to obtain good canes is perhaps even more than in Java and one could say that here the recovery of sugar starts in the fields, whilst in India, in many factories, the recovery starts at the weighbridge, by making deductions in weight or price. Improvement is only possible by educating the ryots to produce more cane per acre and better cane, but it will be a slow process.

Criticism has also been launched against the type of machinery installed, but we must not lose sight of the fact that cheapness was one of the principal conditions laid down by the new factory owners. As competition was so keen, and everybody copied specifications, there was soon a similarity between the equipment offered by British manufacturers.

Generally speaking, the equipment of the Indian sugar factories is as good as that of similar factories in the world, but it cannot be denied that the operation of the installations was, in the beginning, not very good and still leaves much to be desired. It is easier to build factories than to find experienced operators and the training of staff and labour requires time and patience.

My experience has been that the blame put on defective equipment is in most cases due to lack of operating experience.

In the Mandya Factory, the gradual increase in capacity has in no small measure been due to the experience gradually gained by staff and labourers. India produces many young men who have received an excellent college education and who after several years training have proved to be efficient operators. It has been my experience that it takes 5–6 years to train an unexperienced staff and the labourers to operate the complicated process of white sugar manufacture.

There is another reason why conditions in India are so different from those in the P.I. All factories here make plantation white sugar which requires considerably more skill than the making of cargo sugar of 96 polarisation. Not only is the machinery more complicated, but it needs more frequent cleaning and heavier operating charges through the larger amount of chemicals, some of corrosive nature, employed in the white sugar process.

We have in India sulphitation and carbonatation factories. Equally good sugar can be made by both processes, but as the crux of making good plantation white sugar lies in a perfect clarification of the mill juices, it is easier to obtain good sugars with the carbonatation process where all juice is filtered, than by subsiding, as is usual in sulphitation plants,

Sulphitation of the syrup, from which white sugar is boiled, to a pH of 5 or below, is necessary in both processes to obtain good plantation white sugar with reasonable keeping quality. If the pH rises above 5, good sugar cannot be made. The essential thing to obtain good clarification in a double sulphitation factory is the use of good lime.

The extraction obtained by the mill is of course important when the raw material is purchased for cash. Several factories have obtained an extraction of 93 per cent. In my opinion, this should not be higher in a factory making white sugar, as otherwise, too many impurities are introduced in the mill juice. In order to maintain good extraction, care should be given to the condition of the rollers, returner bars and scrapers and rollers which have worn smooth should be immediately regrooved. This means that spare rollers and a roller lathe must be part of the factory equipment, as well as an adequate supply of returner bars, scraper toes, etc. In many small mills this is lacking, with the result that the extraction suffers, as a result of poor operation, and not as a result of low quality of the original equipment.

Boiling house recoveries in good factories fluctuate in India between 83 and 87, which, considering the large quantity of molasses produced by Indian canes, cannot be considered unsatisfactory. As I said before, recovery should be started in the field; with mature sound canes, higher boiling house recoveries will follow.

The cost of manufacture, that is the amount spent per ton of sugar manufactured, for pay-rolls, chemicals, maintenance of machinery, general machinery supplies, filter cloth, lubricants, fuel or outside electric power, water rate, bags and twine and camp maintenance, is closely connected with the daily output. By making double the amount of sugar, costs will be nearly halved. For this reason anything which interferes with the output, stoppages for lack of cane, breakages, or lack of operating experience are exceedingly costly. The larger the output, the smaller will be the fixed charges per ton of sugar for off-season expenses, interest and Head Office expenses. This again brings us to realise that in order to be successful, a factory must have ample funds, so that the operation will not be interrupted for lack of spare parts.

A sugar factory cannot be run successfully on shoestring finance, and in well-managed concerns, the largest part of the profits is usually reserved for depreciation, purchase of equipment and cash reserves for emergencies. A financially strong concern will also be able to buy better quality cheaper and obtain the largest possible discounts.

The major part of the cost of sugar is the amount paid for the raw material, *i.e.*, the cane. The price paid in India by the factories for the cane is in many cases too high.

The cost of cane should not be more than 50% of what the factory obtains from its sugar sales. Therefore, if sugar prices are Rs. 240 per ton, the factory will obtain about Rs. 200 and the ryot should be paid not more than Rs. 100 per ton of sugar or, with a 10% recovery, Rs. 10 per ton of sugarcane.

If prices go up, the factory can afford to pay a higher price for the cane, but during the last five years, many factories have paid 60% and more of their sugar revenue for their cane. Improvement can, as I said before, only be expected from improved cane cultivation, as below a certain minimum price, the planter would not be able to exist. Improvements in the recovery is having, in most factories, the most careful attention of the management. With better canes, the cost of manufacture could be further reduced. The education of the ryot is a task which Government should undertake by spending some of the excise money for this purpose.

To illustrate what can be done, we have the instance of the Mysore Sugar Company, which held a crop competition, awarding prizes for the best cultivated cane on one-acre plots, five-acre plots and larger holdings. Prizes of Rs. 100 and Rs. 500 were awarded. The result showed what could be done by an intelligent ryot. None of the competitors produced less than 42 tons per acre, one just over 62 on a one-acre plot, one averaged over 43 tons per acre on an 18-acre plot. The sugar contents were over 17, the purities of the juice over 88, in some cases, considerably over these figures. Apart from the prizes, the ryots were rewarded by the very much larger cash returns from the tonnage harvested. The Mysore Sugar Company also operates several farms, mainly with the object to show the ryots, what results can be obtained when proper attention is given to the selection of cane and its cultivation. Manurial experiments are being made every year, not only with artificial manure, but with molasses, molasses lime powder and compost made from all refuse collected at the weighbridges.

Before closing, I should like to say a few words on the use of the by-products of the sugar factory, which has been given quite a bit of attention in India. The one and only profitable way to use the waste molasses is by converting it into alcohol. The best way to do this is by having a distillery attached to the factory so that any surplus bagasse can be used to operate the distillery. In Mysore, the distillery was erected in the second year of the factory's operation and has proved to be a very good investment. Rectified spirit (96°) is mainly manufactured, besides a small quantity of potable spirits for local consumption. All tractors, locomotives, service automobiles and lorries of the Company are operated on denatured rectified spirit or on a mixture of 2 parts spirit and 1 part petrol.

The Indian chemical industries can absorb large quantities of alcohol. Alcohol is the base of many modern explosives and the manufacture of acetone is being considered in Southern India. Rectified spirit of 96°, although making a good motor fuel in high percentage alcohol mixtures, cannot be used in petrol motors without making slight changes. The fuel is, therefore, not interchangeable with petrol. Moreover, the amount of petrol consumed in

India is so large that there would never be enough alcohol to permit the admixture of a large alcohol percentage.

In order to make the mixing of alcohol with petrol commercially possible, the rectified spirit must be dehydrated. Committees have been appointed to study the possibilities of the manufacture of dehydrated rectified spirit or absolute alcohol and the required legislation for the exclusive use of petrol alcohol motor fuel. Mysore State has taken the lead and has now an absolute alcohol plant in operation, and legislation is expected to be passed early next year making the mixing of all petrol sold in the State with a certain percentage of absolute alcohol obligatory.

The maximum percentage is 25%, but when all molasses manufactured in Mysore State is distilled into Absolute Alcohol, not more than 10% of the petrol consumption will be available. Even a 20% mixture will not require any adjustments to pertol motors. In fact the alcohol-petrol mixture will be a fuel of higher octane, slower burning, therefore less liable to "pinking", give less carbon deposit and less carbon monoxide in the exhaust gases. Even when using 96° pure alcohol, there is no difficulty in India in starting from cold, so that the petrol-alcohol mixture will provide a better fuel than the low grade petrol now sold in South India. If all waste molasses produced in India could be made into absolute alcohol, it would mean a large revenue to the sugar industry and an invaluable asset in case of war.

Other by-products of the factory are the surplus bagasse, but this is seldom available when "noble" canes are being cultivated. The best use of surplus bagasse is as fuel to run a distillery. Paper and Celotex manufactures are major industries requiring a huge capital outlay. Then we have the filter press mud, from which a kind of inferior wax can be obtained, but the best use is, in my opinion, to spread it on the fields, in order to correct bad soil conditions. We have also, ashes, which are useful for soil correction or can be used to fill insanitary holes. The fine ash dust we give to the Malaria Control Board, to mix with Paris green. The mixture is blown over stagnant water pools in order to kill the mosquito larvæ.

In closing, I would like to state that the Indian Sugar Industry has grown from a very promising infant to a well-grown youth, whose behaviour might be criticised, but who gives promise to grow into a mature and useful member of the Indian industry and who fully deserves the support and encouragement of its father, the Government of India.

Indian Central Jute Committee
Technological Research Laboratories

THE laboratories were officially opened on January 3rd, 1939 by His Excellency the Viceroy, in presence of His Excellency Lord Brabourne. The foundations were dug in early February 1938 and the building and equipment were ready for the staff to go into occupation in early September.

The laboratories are situated in Regent Park, just outside the Tollygunge municipal area, about five miles south of Calcutta. The central block contains on the ground floor the Manager's office, jute godown and machine store, and on the first floor, the Director's office, general office and sample-room. The tower portion contains the main staircase and, on the second floor, the main water-tank. In the east wing there are three large, air-conditioned rooms which contain the spinning machinery, comprising a jute softener, teaser card, warp and weft breaker cards, warp and weft finisher cards, drawing frames, roving frame and spinning frames, all being of the most modern type. The machines are provided with individual electric motors, the drives being by V-ropes except in the case of the softener. A vary-pitch V-rope drive is fitted to one of the spinning frames. The drawing frames and the roving frames are each divided into two sections, one for the finer yarns and one for the coarser yarns. Each spinning frame has twenty spindles, one being for the finer yarns and one for the coarser yarns.

The spinning machinery has been provided with the object of enabling spinning trials to be made on small samples of fibre under controlled conditions.

The immediate objects of the investigations which are in progress are, firstly, to make reports on samples of fibre resulting from breeding trials, manurial experiments and the like and on any other samples which are sent for appraisement such as samples taken from the various jute-growing areas in connection with the Committee's marketing investigations. Minor modifications are being made in the spinning machinery in order that reliable information may be obtained from quite small samples (say 20 to 160 lb.) and special precautions are taken to ensure that the yarn produced accurately represents the sample of fibre under test.

The second main object of the early work in the laboratories is to find out what connections there may be between the various measurable characters, whether physical or chemical, of the raw fibre, its behaviour in spinning and the quality of the yarn produced. When this object is achieved it will be possible, by examining a representative sample of fibre, to predict its spinning quality and so to assess accurately its value. It may ultimately be possible to devise simple tests suitable for use in markets and baling houses.

The air-conditioning plant, which has been installed so that all tests may be made under standard conditions of temperature and humidity (80° F. and 75 per cent. Relative Humidity), is housed in the west wing of the buildings. This wing contains also the boiler, transformer and the tube-well pump. An open space has been left between the central block and the west wing in order to allow the south breeze to reach the range of the laboratories (chemical, physical and testing) situated along the north side.

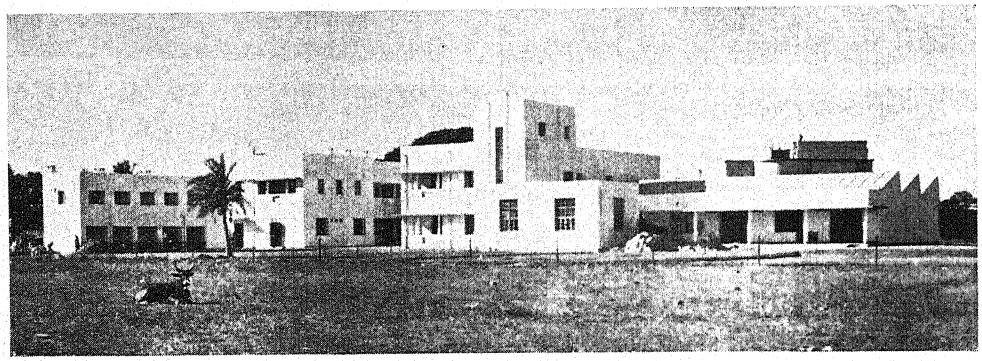
The chemistry laboratories are well equipped for carrying out the analysis of fibre samples in order to find out the proportions of the more important constituents (cellulose, lignin, pectin, etc.) and for the determination of other characters which may be expected to show a correlation with spinning quality. Town's gas is not available and a petrol-air gas plant has, therefore, been installed to supply the laboratories. A considerable portion of the apparatus is electrically heated.

The main work of the physical laboratories is to devise and perfect methods of measuring the properties, such as strength, fineness and flexibility, which are likely to be connected with the spinning quality of fibre.

Two testing laboratories have been provided and in both the standard conditions of temperature and humidity are maintained. In the smaller room there are instruments for measuring the tensile strength of yarn. The larger testing laboratory contains instruments for measuring the strength, fineness and flexibility of fibre and further instruments for the testing of yarns, including a "ballistic" yarn tester.

In all the tests statistical methods are in use for assessing the reliability of the results. In single thread tensile strength tests on yarns, for example, it has been found necessary to take the mean of at least three hundred tests. This gives a twenty-to-one chance that a difference of six ounces between the tensile strength of two yarns with a strength of about 10 lb. is a real difference. Similarly, in measuring the twist (turns per inch) of a yarn, the mean of one hundred tests is taken.

In the larger testing laboratory there is an electrically heated "moisture oven" of the latest type for determining the moisture content of samples. The checking of the moisture content of fibre is important for at least two reasons. If the moisture content is unduly high, the fibre is liable to deteriorate in storage, owing to bacterial action and further, a high moisture content means that water is being bought and sold instead of fibre. On the first floor, over the testing laboratories, there is a roomy library.



A representative range of scientific and technical journals is being taken in regularly and back numbers of several important journals have been obtained. The nucleus of what is hoped will develop into a valuable collection of text-books bearing directly or indirectly on the jute industry, has been collected. A classification suitable for a specialist library relating to jute has been worked out and the indexing of articles and information relating to jute has been commenced.

In a separate building to the south of the main block, workshops have been erected in which work required in connection with the spinning laboratories may be done and instruments and apparatus required by the chemist and physicist may be constructed. On a terrace over the chemistry and physics laboratories, there is a space where further laboratories may be built to meet future requirements. Room for extensions is also available to the east of the spinning rooms and in the south portion of the compound.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Bussiere, Paul (*d.* 1739)

PAUL BUSSIERE, a French Anatomist, fled his country on account of his being a Protestant. He was naturalised in England, where he soon attained high reputation. He attended on Queen Caroline. According to Lord Harvey, the King and Queen had a great opinion of him and preferred him to every other man of his profession.

His Contributions

Bussiere was one of the first to introduce a course of lectures on anatomy into England. He was a Member of the Royal Society and contributed six papers to its *Philosophical transactions*. He also published two books: (1) *Lettre a M. Bourdelin pour servir de reponse an sieur Mary sur L'usage due trou oval dans la fœtus* (1700) and (2) *Nouvelle description anatonique du cocur des tortues terrestres de l'Amerique et de ses Vaaisseaux* (1713). He also contributed frequently to the *Memoires* of the Academy of Sciences of his native land.

Bussiere died at London, January 1739.

Gabb, William More (1839–1878)

WILLIAM MORE GABB, an eminent American Palæontologist, was born in Philadelphia, January 20, 1839. His parents kept a millinery shop. He graduated in Classics in 1857. But his interests were in minerals and fossils. Hence he spent the next three years in studying under James Hall, the foremost among the then palæontologists of America. He formed useful contacts with many experts by frequent visits to the Academy of Natural Sciences and the Smithsonian Institution.

His Career

In 1861 he was appointed palæontologist on the Geological Survey of California. In 1867 he went to survey the Lower California. From the next year he surveyed Santo Domingo for about three years. In 1873 he did similar work in Costa Rica, where exposure to costal fever damaged his lungs.

His Contributions

Even in his twenty-second year, Gabb was considered to be the best authority on cretaceous marine palæontology. He contributed as many as 88 papers in his short span of thirty-nine years. Fifteen of these were on cretaceous fossils. The whole of the second volume and nearly a half of the first volume of the palæontological series of the Geological Survey of California were from his pen. V. 20 of Petermann's *Mittheilungen* contains his report on Lower California. The *Transactions* of the American Philosophical Society contains his memoir of 200 pages on the island of Santo Domingo. The geographical part of his work on Costa Rica appeared in 1875 as a Government publication; but before the palæontological work could be published, Gabb died of consumption, May 30, 1878.

Vernon-Harcourt, Leveson Francis (1839–1907)

LEVESON FRANCIS VERNON-HARCOURT, a British Engineer, was born in London January 25, 1839. His grandfather was Archbishop of York. Having had his earlier education at Harrow and Oxford, he learned engineering under Sir John Hawkshaw from 1862 to 1865. From 1866 to 1870 he was resident engineer at the East and West India Docks. After seeing service under several harbour authorities, he settled down in London in 1878 for consulting practice. From 1882 to 1905 he occupied the Chair of Civil Engineering in the University College, London.

His Contributions

As consulting engineer, he acted for a number of public bodies—chiefly harbour authorities, canal and other navigational authorities. He was the author of eighteen papers, published in the *Proceedings* of the Institution of Civil Engineers. He also contributed several others to the Royal Society, the British Association and the Navigation Congress. His chief books are *Rivers and canals* 2 V. (1882), *Harbours and docks* (1885), *Civil engineering* (1902) and *Sanitary engineering* (1907).

His Visit to India

In 1896 he came to India at the request of the Calcutta Port Authorities to inspect and report on the navigation of the Hooghly. His report appeared in the *Proceedings* of the Institute of Civil Engineers, in 1905. In 1906 he was a member of the International Consultative Commission for the Suez Canal works.

His Honours

His reputation stood high in Europe. He was appointed as a member of the Jury for the Paris Exhibition of 1900 and the St. Louis Exhibition of 1904. Next year he was President of the Mechanical Science Section of the British Association. For his services on an international jury in Vienna in connection with schemes for large canal lifts, he was made a Commander of the Imperial Franz-Joseph Order of Austria-Hungary. His essey *On the means for improving harbours established on low and sandy coasts like those of Belgium* was placed second. He was also awarded a Telford medal, a George Stephenson medal, Telford premiums and a Manby premium. He bequeathed a 1000 *l* to the Institution of Civil Engineers to provide biennial lectures on his subject.

After a few weeks' illness Vernon-Harcourt died at Swange, September 14, 1907.

ASTRONOMICAL NOTES

Planets during February 1939.—Mercury will be visible as a morning star for a few days in the beginning of the month; on February 19, it is in superior conjunction with the Sun and will afterwards become an evening star. Venus is gradually moving towards the Sun, but will still continue to be a bright object in the eastern sky visible for some time before sunrise. Mars also can be seen about the same time near the meridian in the constellation Scorpio; and when it is near the first magnitude star Antares (α Scorpii) which is approximately of the same brightness and reddish colour, the two objects will present an interesting appearance in the morning sky.

Jupiter being too near the Sun, is not favourably situated for observation. Saturn is slowly moving eastward along the southern border of the constellation Pisces, and will be visible towards the west for about three hours after sunset. The rings continue to widen and the angular dimensions of the axes of the ellipse are 37″·5 and 6″·4 respectively. Uranus is in the constellation Aries and will be an hour west of meridian at sunset. The following close conjunctions of the Moon with planets may be noted:—February 12, Mars; February 15, Venus; and February 25, Uranus. Lunar occultations of some interest that can be observed in these latitudes are—α Virginis (Spica), magnitude 1·2 on February 8 and β' Scorpii, magnitude 2·9 on February 11.

T. P. B.

SCIENCE NOTES AND NEWS

New Year Honours.—The New Year Honour list contains the following names of scientists:

Knighthood: MAJOR H. G. HOWARD, Chief Engineer for Electricity, Madras; COL. A. J. H. RUSSELL, I.M.S., Public Health Commissioner, Government of India.

C. I. E.: DR. W. BURNS, I.A.S., Agricultural Expert to the Government of India, Imperial Council of Agricultural Research Department; MR. H. B. DUNNICLIFF, Chief Chemist, Central Revenues Chemical Service and Principal, Government College, Lahore; LIEUT-COL. G. COVELL, I.M.S., Director, Malaria Survey of India.

Rao Bahadur: MR. V. RAMANATHA IYER, Cotton Specialist, Coimbatore.

Rao Sahib: MR. M. G. PATHALE, Research Assistant in Botany, Agricultural College, Cawnpore; MR. SURJAKANTA MITRA, Assistant Professor of Physics, Science College, Patna.

O. B. E.: MAJOR D. P. BHARGAVA, Professor of Surgery, Prince of Wales Medical College, Patna.

M. B. E.: MR. D. C. CHAKRAVARTI, Professor of Clinical and Operative Surgery, Medical College, Calcutta.

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The Intensity of Solar Radiation.—The hourly and seasonal variations in the solar radiation at Poona, have been recorded in a recent publication of the Indian Meteorological Department (P. K. Raman, *Memoirs of the Indian Meteorological Department*, 1938, 26, Part VIII). The intensity of radiation coming from the sun and from the sunlit sky is a factor of fundamental importance in meteorology and in the study of bioclimatic phenomena. Long records of radiation measurements are confined to a few stations in Europe and North America. In India, work on this subject was started in 1934 at Poona, and the *Memoir* recently issued incorporates the data obtained for all the days for which the data were available in 1935.

The Moll solarigraph was employed for the measurement of the total radiation. The maximum amount of radiation recorded during the year was 855 gm. calories (May 4) and the minimum, 116 gm. calories (July 20). During the summer months, April and May, the mean daily radiation recorded was 784 and 775 gm. calories per day respectively. During the monsoon months, the energy is small, *e.g.*, 388 gm. calories per day in July. The value changes to 600 in November, 478 in December and it steadily increases to the summer maximum.

The maximum radiation epoch occurs at noon during all the months. This epoch is not pronounced during the monsoon months.

It has been observed that a covering of the cirrus clouds does not affect, materially, the total radiation recorded on a horizontal surface. A sheet of cirro-stratus clouds decreases the total radiation by about 10 per cent., while a thick cirro-stratus diminishes the intensity by 20 per cent. Medium clouds cut off more of the incoming radiation.

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Mineral Production in India.—Among the chief sources of production of manganese in the world, India occupies the second place with 1,051,594 tons valued at £3,229,554 in 1937. Russia has the pride of place. The United Kingdom is the chief importer of Indian manganese ore. The industry has shown a gratifying recovery, and its output this year reached the peak point of 1927 (1,129,353 tons valued at £2,703,068). In 1933, the production had diminished to one-fifth of that of the peak year 1927, but its value was only one-twenty-second part of the value of the 1927 production.

The fall in the price of the manganese ore from 1924–32, is to be correlated with the fact that during the period 1924–27, the rate of increase in the production of manganese ore was much greater than that in the world's production of pig iron and steel. There was

a disastrous decline in the activity of the iron and steel industry during the years 1931–32. The world's available supplies of manganese ore are much in excess of normal requirements. Russia is able to place large quantities of ore on the market, at a price which many Indian producers are unable to compete.

There is now a steady consumption of manganese ore at the works of the two principal iron and steel companies, not only for use in the steel furnaces of the Tata Iron & Steel Co., and for the manufacture of ferro-manganese, but also for addition to the blast furnace charge in the manufacture of pig iron. The consumption of ore by the Indian Iron and Steel Industry in 1937 was 60,219 tons.

Regarding the production of iron ore, India is the second largest country in the British Empire. The output, 2,896,258 tons valued at £352,487, however, is completely dwarfed by the production of the United States (48,750.000 tons in 1936) and France (32,300,000 in 1936), but her reserves are not much less than ¾ of the estimated total of the United States and there is every hope, that India will eventually take a more prominent place among the world's producers of iron ore.

The Tata Iron & Steel Co. produced 885,393 tons of pig iron, 665,309 tons of steel and 8,041 tons of ferro-manganese in 1937. The corresponding figures for the previous year were respectively, 858,272, 660,291 and 3,263. The total production of pig iron in India was 1,621,260 tons in 1937. Japan continued to be the principal importer of Indian pig iron.

The production of petroleum in India reached, in 1937, the highest figure in the history of the industry (350,322,222 gallons). At the end of 1937, there were 2,910 wells producing in the field. India, however, contributed only 0·50 per cent. to the world's production of petroleum during the year, and of this 0·40 per cent. came from Burma, and only 0·10 per cent. from India proper. The contributions from some other important petroleum producing centres were: U.S.A. 62·7 per cent., Russia 9·9 per cent., Venezeula 9·2 per cent., Iran 3·8 per cent., Netherland Indies 2·6 per cent., and Rumania 2·5 per cent. The production methods employed throughout the field are characterised by a realization of the importance of the conservation of oil and gas and the prevention of waste, whether surface or underground. During the year, the Burma Oil Company's deep test well at Monatkon was abandoned at 8,319 feet, as no productive sand had been encountered.

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Report of the Coal Mining Committee.—The discussion on the Report arranged under the auspices of the Geological, Mining and Metallurgical Society of India, has now been issued in the form of a bulletin (No. 2, June 1938). The criticisms on the report, range in detail over practically every relevant point, investigated by the Coal Mining Committee, the chief among them being stowing and conservation of coal. The critics are unanimous on the following issues:—Stowing should not be insisted upon in every case, but had better be confined to specific mines, where fires are frequent. The cess proposed in stowing is too large and should, in the first instance, be anna one or so, to be enhanced later, when the actual cost has been studied. The Indian Railways are the worst delinquents in the utilisation of coal and should be directed to use inferior grade. A Research Station to investigate into the possible methods of conserving coal, and of safe and economic methods of mining it, as contemplated by the Committee, is a salutary proposal, but at the first instance, it is preferable to start such researches in the existing institutions as the Indian Universities, the Indian School of Mines and the Geological Survey of India. The dissenting minute by Drs. Nag and Krishnan advocating the nationalization of coal mining, is the only cure for the present ill-management, unsafe mining and unhealthy competition obtaining in the collieries. The appointment of an appellate authority is welcome, but its personnel, salaries of staff and other details should be on more economic and useful basis. The Railways should treat coal freight on exactly the same preferential basis as is current in South Africa.

Other members who took part in the discussion—Messrs. N. N. Chatterji, S. C. Ghosh, M. M. Mukherji and J. S. Bhaduri, Professors S. K. Roy and C. Forrester, and Dr. S. K. Sarkar—have offered suggestions on various technical points such as the desirability of studying the hydrogenation of coal, the utilization of the by-products, the electrification of a part of the railway, the use of brick and dust coal in the railway engines, the method of stowing to be employed, the desirability of grading coal, the method of improving on Dr. Fox's estimate of the coal reserves, and the participation in and allocation of a group of the officers of the Geological Survey of India for exclusively engaging themselves in such economic investigations of national importance.

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The Friction of Shoe Brakes applied to a vehicle in motion, is a very important factor in finding out the stopping distance of the Vehicle. This problem with respect to Railway shoes brakes was investigated from 1880 to 1930, and a large amount of experimental work was done to determine the coefficient of friction of Railway brake shoes under varying conditions of speed and brake shoe pressures. The experiments were limited to maximum speed of 65 miles per hour and pressures of 15,000 lbs. With the general increase in speed of all trains at the present day, the existing data had to be supplemented by further data to bring them up to date. The Engineering Experimental Station of the University of Illinois, in the Department of Railway Engineering, undertook this as part of their work, and the results have been published in their Bulletin 301, entitled "The Friction of Railway Brake Shoes at High Speed and High Pressure" by Herman J. Schrader, 1938. "The main purpose of the tests was to determine the coefficient of friction of brake shoes, the stopping distance, and the brake shoe wear under conditions which

simulate those that prevail on the road in stopping trains that travel at high speeds."

The investigations were conducted on brake shoe pressures, varying from 4,500 lbs. to 20,000 lbs. and under each of these pressures, stops were made from initial speeds of 60, 80 and 100 miles per hour. Two different patterns of shoes, one light and the other heavy, were tested, and in each pattern there were chilled-end shoes and also those with plain ends, ground to shape. The wheel tested was the "multiple wear" rolled steel wheel of the American Railway Association standard design, 33 inches diameter, for use on 6-inch and 11-inch axles, chosen by a representative of the University from the wheel stock of a Western Railroad Company. The wheel weighed 773 pounds and was 8·66 feet in circumference. All the tests were made on the brake shoe testing machine of the University, consisting essentially of a car wheel keyed to a main shaft which carries also a heavy flywheel, the system being rotated at any desired speed by means of a steam engine, which drives the shaft through a pulley and clutch. The shoe to be tested is held in a brake shoe head and is suspended above the wheel from one of a system of levers, by means of which the shoe may be applied to the wheel at any desired pressure up to 20,000 lbs.

The tests conclusively proved that, with the particular types of shoes and kind of wheel tested, no cast iron brake shoe should be subjected to braking condition which will require it to perform and dissipate more than 90,000 ft. lbs. of work per sec. Also, if the building up of the brake shoe material on the wheel tread is to be avoided, the workrate performance of the shoe should be kept below 70,000 ft. pounds per sec. Another important conclusion was that pressures of 20,000 lbs. combined with high speeds, cracked the wheel tread at a very rapid rate, and in order to avoid this type of failure, the rate of performing work on the wheel should be kept below 125,000 ft. pounds per sec. The heavy pattern shoes are more economical than the lighter pattern; but the chilled-end shoes were not superior to plain-end shoes when tested at high speeds and high pressures. K. B. K. R.

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Molecular Distillation.—In a series of four important papers read before a joint meeting of the Chemical Engineering Group and the London Section of the Society of Chemical Industry, various aspects of the subject of Molecular Distillation and its technical applications were discussed. The first practical application of molecular distillation began nine years ago, but on account of the necessity for employing extremely low pressures of the order of 10^{-6} atmospheres, the technique could not be developed till improvements and developments were made on Langmuir's original condensation pump, which enabled high vacua of this order being obtained on a technical scale.

On account of the extremely low pressures employed in molecular distillation, the rate of distillation depends on the saturation pressures of the distillant. An apparatus consisting of a shallow pool of heated liquid with a condensing surface of a few centimetres above it is used, the whole being enclosed in a chamber which can be evacuated to a pressure of 10^{-6} atmospheres or less. It is very important to remove traces of uncondensable gases dissolved in the liquid or produced by slight decomposition and various special methods have been developed to effect this.

The most recent and perhaps the most important application of Molecular Distillation is the isolation of Vitamin A directly from the fish-liver oils. Before this, Vitamin A concentrates were prepared from the unsaponifiable portion of the oil. Messrs. British Drug Houses, Metropolitan Vickers and Imperial Chemical Industries in England and the Eastman Kodak Co. in America, have been associated with these developments. The work done on the Molecular Distillation of fish-liver oils has shown that Vitamin A occurs in these oils in the form of esters and Tischer isolated it in the form of a palmitate. Crystalline Vitamin A, melting at a temperature of 7° to 8° has also been prepared, by Molecular Distillation and is expected to have a potency of about three million international units per gram. Further work on this subject is being pursued actively and more interesting developments are awaited.

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Salmon of the River Shannon, Ireland.—Arthur E. J. Went of the Department of Agriculture, Fisheries Branch, Dublin, has in his paper on "Salmon of the River Shannon" (*Proc. Roy. Irish Acad.*, Vol. XLIV, Section B, No. 11, pp. 261 to 322) given a very instructive account of the analysis of the salmon stock of the year 1927 and the growth of salmon smolts in the River Shannon from an examination of vast material collected from the net fisheries at Lax Weir and Glin Co., Limerick and from the rod fisheries between O'Briens Bridge and Killaloe. In the body of the paper the author gives the results of examination of scales and extensive data and graphs indicating the periodical growth of smolts. The factors governing the smolt migration has also been discussed. In the 1927 stock 98 per cent. of the total catch formed one and two year smolts. April, May and June are stated to be the most important months from the point of view of the commercial catches. It has also been observed that there is a decrease in the percentage of females with the increase in the age of the fish. The spring fish appear to improve in condition with age better than the summer fish. The fastest growing smolts were the first to migrate. This paper by Arthur Went is indicative of the high class work that is being done in the Fisheries Department in Ireland.

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Breeding Habits and Early Development in Hill-stream Fishes.—Mr. S. Jones of the Department of Agriculture and Fisheries, Travancore, has made an interesting contribution to our knowledge of the breeding habits and early development of two of the hill-stream Cyprinoid fishes—*Danio* (*Danio*) *malabaricus*

(Jerdon) and *Garra ceylonensis ceylonensis* (Bleeker)—(*Ceylon Journ. Sci.*, Sec. C, Fisheries, 1938, 6). The author after an extensive search for the eggs of these fishes in the mountain torrents of Ceylon was able to locate their breeding places. The eggs of *Danio* have been observed to be deposited among the algal growth in the shallow regions of the stream, whereas the eggs of *Garra* were found loose on the bottom of the fairly calm water in larger pools close to the bank beneath the algæ. A good account of the early development of both the forms has been given. The most interesting feature in the early devlopment of *Danio* is the presence of a large cement organ in the mid-dorsal region of the head. The secretion of this gland helps the larvæ to attach themselves to the algal filaments until the yolk is absorbed and the pectoral fins are developed. This is a very interesting case of adaptation to life in hill-streams. The presence of a cement organ during the development of a cyprinoid has been recorded for the first time.

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Cytoplasmic Inclusions in *Spirostomum*.—While our knowledge of the structure, distribution and function of the Golgi apparatus and other cytoplasmic inclusions in the Metazoa is fairly extensive, the findings in the Protozoa are very meagre and conflicting. Since the time Nassanow's theory that the contractile vacuole of the protozoan was homologous with the metazoan Golgi apparatus was refuted, many attempts have been made to determine its structure and position and K. M. R. Browne (*Journ. Roy. Micros. Soc.*, 1938, 48, Pt. 3) has studied it in *Spirostomum ambiguum*. Using almost all the classic methods, he has demonstrated the presence of the Golgi bodies as spherical structures, blackened by osmic acid but not revealed by silver techniques and scattered all over the cytoplasm. They appear to have an osmophile membrane surrounding an osmiophobic medulla. They apparently have no connection with the contractile vacuole whose wall in *Spirostomum* is not osmiophilic. The mitochondria are more numerous and are also scattered in the cytoplasm. They are in the form of deeply staining discoidal rods.

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A New Teak Planting Technique.—In the past, teak plantations were formed either by direct sowing of the seeds or by transplanting small seedlings at the beginning of the rains, but with either of these methods, results were frequently irregular, and partial failure of the plantations was a common experience. The rate of growth of the young teak plants raised by these methods was moreover slow and the cost of keeping them from being swamped by the vigorous weed growth experienced in moist west-coast localities was correspondingly high.

More recently, experiments conducted in Madras by A. L. Griffith (*Indian Forest Records*, Sylviculture, 3, No. 2) have proved that far more regular results can be obtained by planting out stumps, prepared by digging up one-year-old nursery seedlings and cutting off the shoot at about one inch above and the root at about 8 or 9 inches below the original ground level and trimming off all side roots. These stumps are much more resistant to adverse weather conditions after planting, give higher survival percentage and grow faster than either direct sowings of seed or planted nursery seedlings.

Carefully planned experiments have shown that the best date for planting was mid-April or early May. The survivals may be as high as 99 per cent. The results were unexpected and surprising. The stumps very often experienced an almost complete drought for anything from ten days to three weeks after planting, while the soil was baked hard and dry. At first it seemed inconceivable that they could survive such early planting and much less, give improved results, and it took five years to prove definitely that early planting was not only feasible but reliable and very beneficial. It is emphasised, however, that these results have been obtained for localities with a west-coast climate and that, while some degree of early planting is probably beneficial in most teak planting areas, local experiments must be carried out to determine the earliest safe date in each case, otherwise expensive failure may be experienced. The experiments are now being extended to drier localities.

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Pasteur Institute of South India, Coonoor.—The Annual Report of the Director for the year ending 31st December 1937, records an extension of the activities of the Institute over those of the previous years. The Paris fixed virus was used exclusively in the preparation of the vaccine. It was in its 994th passage at the close of the year. Semple's 5 per cent. carbolised sheep brain suspension was the vaccine in use. 426 patients underwent treatment at Coonoor, and 15,371 courses of antirabic vaccine were issued to the subsidiary centres. The mortality rate for all treated cases (complete and incomplete) was 0·15 per cent. 31 new subsidiary treatment centres were opened during the year in the Madras Presidency.

Antirabic vaccine is also available for the prophylactic treatment of animals. During the year, 34,720 c.c. of 5 per cent. carbolised sheep-brain vaccine was issued for the treatment of animals, chiefly to veterinary officers in the Madras Presidency and neighbouring Indian States.

The Institute continued to receive clinical specimens from hospitals and medical practitioners in the Nilgiris District for bacteriological examination. 4,382 such specimens were examined during the year.

A special meeting of the members of the Association of the Pasteur Institute of South India was held at Coonoor, on 10th June 1937, when a resolution recommending that certain definite lines of research connected with rabies should be undertaken at the Institute under the direction of the Director of the Pasteur Institute, was adopted. The lines suggested were: Extension of the work which was already being done with the object of obtaining concentrated rabies

virus by cataphoresis method; investigation by culture methods, of the nature and identity of rabies virus; and any allied research bearing on the subject of rabies, such as the effect of administration of vitamin to infected animals.

Dr. Veeraraghavan, M.B.B.S., has been appointed Special Research Officer for a period of five years, with effect from 21st March 1938.

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Educational Broadcasts.—The Madras Station of the All-India Radio has issued a pamphlet giving the programme of educational broadcasts for the first quarter of 1939. The programmes are transmitted on the medium wave and are of half-hour duration: (1) 2 p.m. to 2-30 p.m., for the benefit of the pupils of the High School, and (2) 4 p.m. to 4-30 p.m. for children. The programme for the High School pupils includes "Things of Interest", (5 minutes) from the news of the world, and talks lasting for 15 minutes on topics of scientific and general interest. The programmes for children also include talks on subjects of general interest, physical and natural sciences, biography, history, geography, etc., the treatment being adapted to the psychology of the child, which is able to intelligently understand a subject, if it is presented in suitable form such as a story. The talks will be in two languages, Telugu and Tamil.

It is indeed very thoughtful on the part of the Station Director to have printed the programme in the form of a booklet and made it available to the different schools and members of the public. The Madras Station has been doing commendable work in harnessing the radio for educational work.

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Mining, Geological and Metallurgical Institute of India.—The following prize and medals for papers on mining and metallurgical subjects were announced at the meeting of the Institute held on January 13:—

(1) The Government of India Prize of Rs. 500 and the Institute Gold Medal were awarded to Mr. J. Thomas for his paper entitled "Methods of Stowing for Indian Mines"; (2) The Institute Silver Medal to Dr. Cyril S. Fox, for his paper entitled "Mineral Developments in Soviet Russia"; and (3) The Institute Bronze Medal to Mr. P. N. Mathur for his paper entitled "Small-scale Manufacture of Iron and Steel in India by the Direct Method".

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Benares Hindu University.—His Exalted Highness the Nizam of Hyderabad has donated one lakh of rupees to the Benares Hindu University, towards the endowment of a Chair of Indian Culture, with a view to promoting Hindu-Muslim unity.

The Cochin Durbar have endowed a Chair to be called "Rama Varma Chair" and have been pleased to donate a sum of Rs. 9,000 as yearly recurring grant, to the University.

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University of Calcutta.—Dr. Girindrasekhar Bose, D.Sc., who acted as the Head of the Department of Psychology, University of Calcutta, has been appointed University Professor of Psychology for a period of five years.

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University of Mysore.—Dec. 1938. *University Extension Lectures*: The following lectures were delivered under the scheme of Extension Lectures during the month:—(i) Mr. S. G. Vaze, "The Treatment of Minorities in Czechoslovakia", in English at Bangalore and on "Czech-German Settlement of Munich". (ii) Mr. V. N. Rangaswami, M.A., B.Sc. (Tech.), A.M.C.T., A.M.I.E. (India), "Bituminous Materials and Their Uses", in English at Bangalore. (iii) The University Teachers' Association held its Lecture camp during the Christmas holidays in Shimoga from the 23rd to the 27th December 1938.

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Announcements

The annual meeting of the **British Association for the Advancement of Science** will be held this year at Dundee, from August 30 to September 6, under the Presidency of Sir Albert Seward, F.R.S.

Indian Science Congress.—The Twenty-seventh Session of the Congress will be held at Madras, from 2–8 January, 1940. Prof. Birbal Sahni, F.R.S., has been elected General President. The Sectional Presidents will be: Prof. K. S. Krishnan (*Mathematics and Physics*), Dr. S. Krishna (*Chemistry*), Prof. L. Rama Rao (*Geology*), Dr. S. P. Chatterji (*Geography and Geodesy*), Prof. Y. Bharadwaja (*Botany*), Prof. B. K. Das (*Zoology*), Rao Bahadur K. N. Dikshit (*Anthropology*), Mr. J. R. Haddow (*Medical and Veterinary Research*), Mr. E. McKenzie Taylor (*Agriculture*).

The Eighteenth International Congress of Agriculture, organised by the International Confederation of Agriculture (former International Commission of Agriculture), will be held in Dresden from June 6–12, 1939.

An Executive Committee has been formed under the presidency of Herr M. Behrens with Dr. F. Sohn as Secretary-General. This Committee has arranged for the circulation of bulletins, giving information in regard to the preparatory work of the Congress. Communications regarding the Congress should be addressed to the General Secretariat of the Congress, Berlin, S.W. 11, Hafenplatz 4.

Messrs. Edward Arnold & Co., have drawn our attention to an omission in the bibliographical details given in the review notice of the book, entitled "The Behaviour of Animals" (November 1938, 7, 249). The publishers have pointed out that the book is the *Second Edition*. We regret the ommission.

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We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 39, No. 12.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 11.

"Agriculture and Live-Stock in India," Vol. 8, No. 6.
"The Philippine Agriculturist," Vol. 28, No. 7.
"Journal of the Royal Society of Arts," Vol. 86, Nos. 4488–91.
"L'Agricoltura Coloniale," Vol. 31, No. 10.
"Biochemical Journal," Vol. 32, Nos. 11 and 12.
"Journal of the Indian Botanical Society," Vol. 17, No. 5.
"Journal de Chemie Physique," Vol. 35, No. 10.
"Chemical Age," Vol. 39, Nos. 1013–16.
"Transactions of the Faraday Society," Vol. 34, No. 212.
"Indian Forester," Vol. 55, No. 1.
"Forschungen und Fortschritte, Vol. 14, Nos. 34–36.
"Bulletin of the American Meteorological Society," Vol. 19, No. 7.
"Calcutta Medical Journal," Vol. 34, No. 6; and Vol. 35, No. 1.
"Review of Applied Mycology," Vol. 17, No. 12.
"American Museum of Natural History, Vol. 32, No. 5.
"Bombay Natural History," Vol. 40, No. 3.
"Nature,' Vol. 142, Nos. 3604–07.
"Indian Journal of Physics," Vol. 12, No. 5.
"Journal of Research (National Bureau of Standards)", Vol. 20, Nos. 1–5.
"Ceylon Journal of Science," Vol. 6, Sec. C.
"Science Forum," Vol. 3, No. 2.

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Catalogues

"Monthly List of Books on Natural History and Science," December 1938. Messrs. Wheldon & Wesley, Ltd., London.
"Diffusion Pumps for the Production of High Vacua," W. Edward & Company, London.
List of Publications issued by the International Institute of Agriculture (October 1938).

ACADEMIES AND SOCIETIES

National Academy of Sciences, India:

December 17, 1938.—A. C. BANNERJI AND MOHD. NIZAMUDDIN: *Jupiter Atmosphere.* B. P. PANDE: *On the trematode genus* Lypersomum *Looss,* 1939, (Dicrocœllidæ) *with a description of two new species from India.* B. P. PANDE: *Two new species of trematodes from* Anhinga malenogaster, *the Indian Darter or Snake-bird.* S. N. BANERJI AND S. GHOSH: *Changes in the viscosity of agar sol with concentration.* JAGRAJ BEHARI LAL: *Constitution of Santalin.* R. R. BAJPAI AND B. D. PANT: *Further studies of the F-region at Allahabad.* A. B. SEN: *Migration of* para-*halogen atom in a derivative of* meta-*cresol.*

Indian Chemical Society:

October 1938.—JAMIAT V. LAKHANI AND RUSTOM P. DAROGA: *The Determination of the Parachors of Inorganic Salts in Solutions and their Structure—Part II. Some Lithium, Sodium, Rubidium Salts and Atomic Parachors of the above Elements including Cæsium.* K. GANAPATI: *The Chemotherapy of Bacterial Infections—Part I. Synthesis of Some Derivatives of Sulphanilamide.* MAHADEO PRASAD GUPTA AND SIKHIBHUSHAN DUTT: *Chemical Examination of the Seeds of* Cleome viscosa, *Linn.—Part I. The Constituents.* DINES CHANDRA SEN: *Studies in the Camphor Series. Part V—Some Derivatives of* iso-*Nitrosocamphor.* N. R. DHAR AND S. K. MUKERJI: *New Aspects of Nitrogen Fixation and Conservation in the Soil.* N. C. SEN GUPTA: *On the Physico-Chemical Properties of Indian Bentonites—Part I.* B. N. GHOSH AND D. K. CHOWDHURY: *Enzymes in Snake Venom.*

Meteorological Office Colloquium, Poona:

December 1938.—C. W. B. NORMAND: *On Soaring and Gliding Flight.* S. K. BANERJI: *Relationship between upper wind velocity and temperature.* A. K. ROY: *On forecasting of weather in South Bengal during the Nor' wester season mid-March to mid-May.* M. W. CHIPLONKAR: *On brightness of the Zenith sky at twilight and its relation to upper air temperatures.*

The Indian Botanical Society:

December 1938.—L. M. GHOSH, S. GHOSH, N. R. CHATTERJEE AND A. T. DUTT: Actinomyces: *Their Biochemical reactions as aids in their classification—Part I. Reduction of Nitrates.* A. B. SARAN: *A short note on the rate of respiration and respiratory quotient of starved leaves of* Aralia *sp. before and after a course in nitrogen.* M. J. THIRUMALACHAR: *On the morphology, cytology and parasitism of* Uromyces Hobsoni *Vize* (U. Cunninghamianus *Barc*), *A preliminary note.* M. S. MURDIA: *Cytological studies of certain members of the family* Saprolegniaceæ—*Part I.* L. P. KHANNA: *On two species of* Anthoceros *from China.* K. R. RAMANATHAN: *On a form of* Anabænopsis *from Madras.* C. BHASHYAKARLA RAO: *The* Zygnemoideæ *of the Central Provinces, India—I.* V. B. SHUKLA: *On a new species of* Dadoxylon, D. Deccani, *sp. nov., from the Deccan Intertrappean Series.* R. N. SINGH: *The* Zygnemoideæ *of the United Provinces, India—II.*

The Entomological Society of India:

November 9, 1938.— H. R. BHALLA: On Sylepta derogata *Fab., the Cotton Leaf Roller.*—The author describes in detail its bionomics and control. For successful control the following measures were recommended: (1) eradication of ratoon cotton and other alternative host plants such as *Hibiscus esculentus; Althea rosea; Abutilon indicum; Malvestrum tricuspidatum; Urina lobata and Malva parviflora,* (2) Hand picking, (3) dusting the infested crop with sodium fluosilicate or Paris green, in the ratio of 1 : 8, (4) destruction of the shed material, and (5) ploughing the infested fields with furrow turning plough during January and February in order to bury the hibernating caterpillars.

SUPPLEMENT TO CURRENT SCIENCE

Vol. VIII] INDIAN SCIENCE CONGRESS, LAHORE, 1938 [No. 1

Presidential Address

By Prof. J. C. Ghosh, D.Sc., F.N.I.

IN his presidential address to the twenty-sixth session of the Indian Science Congress, Prof. J. C. Ghosh, of Dacca, outlined the achievements of Indian scientists particularly in the fields of Chemistry, pure and applied. While he showed that Professor Simonsen's eloquent appeal, that Organic Chemists in India, should take up the investigation of the natural products, had borne rich fruit during the last decade, he deplored that the enthusiasm for research in organic chemistry had overshadowed the claims of inorganic chemistry in India. He said that "there are no longer any barriers between organic and inorganic chemistry. With our newer ideas of valency, the systematization of the enormous accumulation of chemical facts is no longer the prerogative of organic chemistry. Nor can it be said now that the nature of carbon-carbon links is better understood, in spite of its regularity of behaviour, than the links between the other atoms. The elucidation of the structure of inorganic compounds has to be tackled more or less on the same principles which are familiar to the organic chemist. In the common region of the two sciences a vast body of *organometallic* compounds has emerged, which apart from their interest in micro-chemical process of analysis, are now working miracles in the fields of industry and in the alleviation of human suffering".

He drew pointed attention to the changing attitude and outlook of physical chemists. The appointment of Lenard Jones to the chair of inorganic and physical chemistry in Cambridge, he considered, is a symbolic event. "Of a physical chemist is now demanded not only a sound basic training in chemistry, supplemented by a high experimental skill in handling delicate instruments but also a clear understanding of the higher branches of applied mathematics and statistics".

Prof. Ghosh invited attention to the fact "that outstanding discoveries in chemistry have in recent years been made in laboratories, where inspiring leadership has been associated with large-scale team-work. The paper on the synthesis and constitution of vitamin C appeared from the Birmingham laboratories under the joint authorship of a team of seven workers. Such team-work is, however, yet comparatively unknown in India. It is to be deplored that the idea of close co-operation among the scientific workers, has not taken a firm root in the Indian soil. Is it due to the fact, that the traditional religious atmosphere of India teaches a child to be self-centred, to be complete within himself and to work out his own salvation, unaided and in isolation? Then again, I am told, that a tradition has grown in some institutions, that the senior

member of the staff is given credit for senior authorship in a joint publication, independent of any consideration of the share he may have in the planning and execution of the work. This, if true, is unfortunate, for the highest spirit of co-operation, loyalty and devotion can only be evoked in an atmosphere of impartial justice and deepest sympathy and good-will. Notwithstanding these handicaps, there are pointers to the road of success. In the palmy days when Sir C. V. Raman was Professor in Calcutta, one could easily feel that in his laboratory, the researcher has become forgetful of self and mindful only of the work ahead."

Speaking about co-ordination of scientific knowledge and industrial enterprise the President said that the genius of Professor Bhatnagar has provided a bridge of communication between scientists and industrialists. "Nowhere is the beneficial effects of contact between universities and industry better exemplified than in the programme of researches on oil technology, now carried out under the supervision of Professor Bhatnagar, with the aid of funds provided by Messrs. Steel Brothers."

"The Government of India have, in recent years, done a good deal in promoting researches relating to agricultural industries. The Royal Commission on Agriculture has ardently looked forward to a state of affairs in which the universities will not only initiate agricultural research but will also undertake schemes of research, the importance of which is brought to their notice by the departments of agriculture. This end has been steadily kept in view by the Imperial Council of Agricultural Research. With the aid of funds provided by this Council, long-range schemes of research are in progress in the statistical laboratory at Calcutta, in the chemical laboratories at Dacca, and in the botanical laboratories at Agra, Madras and Benares. The cotton technological laboratory at Bombay, the Institute of cotton breeding at Indore, the Imperial Institute of sugar technology at Cawnpore, the cane breeding station at Coimbatore, the jute technological laboratory at Calcutta and the agricultural research laboratory for jute at Dacca are notable examples of the solicitude of the Central Government for meeting the research requirements of valuable economic crops. Researches on forest products have been organized in the Forest Research Institute at Dehra Dun and the Lac Research Institute at Ranchi. The work that is being done in these institutions has gone far to refute the allegation that Indian chemists are doing little to help industry."

The President welcomed the resolution passed at the conference of the provincial Ministers of Industries recently held at Delhi that "the problems of poverty and unemployment, of national defence and economic regeneration in general, cannot be solved without industrialization; and as a step to such industrialization, a national planning committee should be set up which will formulate comprehensive schemes for the development of industries in India".

He suggested that "as an indispensable adjunct to this planning commission there should be set up an All-India Council of Scientific and Industrial Research with functions and powers similar to those entrusted to the Department of Scientific and Industrial Research in Great Britain".

"The universities of India have a great responsibility to discharge at this juncture. If the process of industrialization is going to

be a forced march in this country it will not do for them to take up an attitude of *laissez-faire*. The forces of nature are the enduring wealth of mankind, but for the solution of India's economic problems and the prosperity of her 380 millions, it is necessary that brilliant young men should be trained up in ever-increasing numbers, who are capable of tapping these sources of wealth. The modern young student of science must realize that while fundamental theoretical work must continue to be basis of all scientific advance, his subject would lose much of its importance, if this training did not fit him for tackling large-scale problems which arise in industries. Simultaneously with the development of industries, there arises in every country a great demand for well-trained personnel to man these industries. Prof. Philips recently estimated that 12,000 graduates in chemistry are employed in industrial pursuits in England. Lord Rutherford even complained that the demand in England for well-trained researchers in physics had outran the supply. Dr. Hamor, Assistant Director of the Mellon Institute for Industrial Research, has estimated that in 1937, America spent about 100 million dollars in scientific and industrial research; and though the expenditure is high, the results have more than fulfilled expectations, even if for a time, some of them may be kept secret. Such a consummation may be long in coming to India, but every effort should be made to prepare the ground in advance. A very good example of what the Indian universities can do in this direction has been shown by Bombay, where an Institute of Textile Chemistry and Chemical Engineering has been established, which in equipment has few equals."

He observed that "the Indian industrialists are not all blind to the value of research as a means of improving production, and in consequence, of increasing the demand. The Tata Iron and Steel Works have led the way by the foundation of a magnificent laboratory at Jamshedpur for the study of alloys of iron and steel. The Lala Sriram Trust contemplates establishing soon at Delhi an Institute on the model of the Mellon Institute of America. The Luxminarayan Bequest at Nagpur may soon begin to yield the beneficial results which the donor so ardently cherished. But when one recalls that most of the industries in India are now sheltered by a tariff wall—call it revenue tariff or protective tariff as you like,—and that a substantial part of the income of the Indian business magnates accrues to them because of this tariff, one has a right to expect a much wider recognition on their part of the need for co-operation between science and industry, and a greater readiness to endow industrial research with a view to cheapening production. Such research is considered, in all enlightened countries, as an insurance against the dark days; and today when the world seems so much out of joint, the enlightened industrialists should do well to consider themselves only as servants of society—essentially moral beings whose main dividends are the benefits, which they confer by providing employment, and by manufacturing commodities essential for the national well-being".

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Dr. Thomas Quayle's Report, 1936–37

THIS document has more than official interest. While those parts of the report dealing with statistics and the general details of the office procedure have an importance of their own, we think that the section, devoted to the consideration of the fundamental problems arising from the residence of a large population of Indian students in Great Britain, deserves special attention. During the period under report there were approximately 1,850 students, distributed all over the University towns throughout Great Britain and Ireland, and this number represents by far the largest single national group which is nearly 70 per cent. of the total from the whole British Empire, and probably nearly 40 per cent. of the combined total numbers of the British Empire and foreign students. Far from showing any symptoms of decreasing, these numbers indicate a marked tendency to increase by the growing volume of the exodus of students from India from year to year. They are not discouraged by the failure of their "returned" compatriots to find suitable employment, though the latter may have earned excellent distinctions in the foreign universities. The cheerful optimism that a foreign degree will considerably swell their value and enhance their prospect of preferment in India underlies the spirit of the annual emigration of young men to Europe. It may be pathetic. It need not be surprising. So long as Government

encourages and upholds the doctrine that academic distinctions in the universities imply a corresponding degree of efficiency in the administrative fields, young men cannot be blamed for cherishing the belief that their salvation lies in acquiring higher qualifications in formal studies at a university abroad. The unemployment of these highly educated young men is a grave problem, and its solution confronts Government and society with issues far more serious than those arising from the unemployed young men turned out by the home universities.

The following passage extracted from the report is interesting in several particulars:

> "It is not too much to say that what is sometimes called in this country the 'Indian student problem' is a matter of vital importance from the Imperial point of view. Whatever the future may have in store, it is indubitable that for the present, and probably for long years to come, India, however marked the progress in its available facilities for advance and research work in all branches, will look to the Occident, and especially let us hope, to this country, for the further intellectual stimulus and training of the best of her sons. And if this assumption be well founded, all the greater obligation will rest on the Government and people of this country to ensure that the young Indians who come are helped in every possible and practicable way to get the best out of their sojourn here, not merely from the view-point of the training and degrees which they obtain, but also from the most important aspect that they should be enabled to feel and find themselves, not merely strangers in a strange country, but members of a community ready to welcome them and to make them feel 'at home', so that they may return to India with experience and as interpreters of the best aspects of English life, both public and private. Such students,—and experience has amply proved how numerous, despite the inevitable failures and misfits,—will undoubtedly prove to be ambassadors of great worth, ready and willing to do all they can to foster the most friendly relations and understanding between the two peoples."

These are noble sentiments, though some of them may be construed as inscriptions on the monument of the modern standards of higher education in India, and others are distinguished for their piety and generous enthusiasm. The implications of this passage are categorically, that the university education in India is definitely inferior, that higher training and a degree in a British University are indispensable for advanced research work in India and that if young Indians are treated with hospitality by the British people, they will establish cordiality of feeling between the two peoples. We suppose that it is pertinent to ask "Who is responsible for the low standard of Indian Universities? What about the standards of Universities in the self-governing Colonies and Dominions?" It is not quite clear to us how higher training in a foreign university confers on its recipient the faculty of undertaking research work of an advanced character. It must be gratefully acknowledged that those who have acquired distinctions at an English or European University have done work often of signal importance and by its merit, such work has been the means of example and inspiration for others. We must also admit with equal frankness that others who had not received the benefits of this superior education, have not permitted their grave misfortune to stand in the way of scientific enquiry and investigation, and their record of work is equally impressive and important. Is it really supposed that the Indian graduates of British Universities, failing to obtain suitable employment and openings

for reimbursing the depleted family funds, will become itinerant preachers spreading in their country the gospel of good-will and fellowship. While remembering gratefully all the efforts made towards promoting their happiness and comfort during the trying periods of life abroad, the Indian students returning to their country naturally look forward for engagements which would be advantageous to themselves and useful to their employers.

Dr. Quayle makes a passing reference to the grievous complaint against the inequity in respect of dispensing overseas scholarships. It may be necessary to rouse the public opinion in Britain to the importance of ensuring that Indian students should have the amplest opportunities of becoming acquainted with the best side of English home and family life, but that the same public opinion both in India and in England should be intensely agitated over the injustice perpetrated by the Royal Commission for the Exhibition of 1851, regarding the award of scholarships under their scheme of Overseas Science Research. Till 1937, India was totally excluded, though the contribution from Indian public revenues for this fund was voluntary and generous, and in that year a solitary scholarship was awarded, and in 1938, two scholarships were granted. It will be remembered that during this whole period extending over two generations, the Dominions and Crown Colonies almost exclusively enjoyed the monopoly, in addition to other important Empire Scholarships. The report observes that "if Indians, in common with other overseas students, could become eligible for such scholarships, and if financial assistance, in some measure at least, from official sources in this country were also made available for the best men from the Indian Universities, to enable them to come here for research or advanced course of study, it would in my view strike a note which would be warmly appreciated and welcomed by Indian opinion". What is wanted is not an expression of excellent sentiments, but the adoption of energetic steps to get the long-standing injustice redressed. By ignoring the claims of India to participating in the benefits of these scholarships, the authorities who are charged with the responsibilities of awarding them, have definitely placed India in a most unenviable position, for which there can be no conceivable justification, and from which she can be extricated by the Inter-University Board acting with spirit and in time in collaboration with the High Commissioner for India. Their joint action should be supported by a well-organised public opinion from the responsible leaders of the cultural life of India, insisting on equity and fair play to their gifted young men.

There is another significant passage in the report which we should like to quote not only for its general importance, but also for its practical bearings: "It is no exaggeration to say, as has been constantly reiterated in these Reports, that India ultimately gains little or nothing, either materially or intellectually, from an appreciable proportion of her young students who annually proceed abroad, and it can scarcely be denied that each year there is a grave wastage which calls for the most earnest consideration." This inability to derive any benefit from their sojourn in Britain is attributed to the fact that many students are not fitted by physique, temperament, training and the assurance of adequate financial resources profitably to prosecute further studies in the West. The remedy proposed to combat this wastage, is to foster the growth of a strong public opinion by Government and the Universities for discouraging the annual migration of such misfits. The implication of the passage we have quoted would seem that

Indian students more favourably endowed, have, on their return from foreign studies, contributed largely to the material progress and the cultural advancement of their country. It is so. But we doubt if it is so as a result of their residence abroad. There is more truth in the general statement "that the young Indian student who leaves his own country for further study or training abroad apparently continues to do so in the belief, only too often encouraged by parents at considerable sacrifice to themselves that on his return his chances of suitable remunerative employment will be considerably increased". The reaction of the young Indian student to the strange and new surroundings, complex and foreign, can be explained only on the basis of his psychological make-up.

Indian students when they leave their parental houses, may be reasonably supposed to have attained the age of mental maturity, duly fortified by the sobering discipline of family life and by the exacting demands of those responsible for his instruction. However, lurking behind his character there are the persistent remains of an instinctive sensitiveness and imaginative sympathy which, when confronted with a bewildering multitude of new social phenomena, and of strange attractions of new points of view, must inevitably disturb and produce even instability of mind. He can hardly struggle out of "the web of the obligations of the family life," nor does he completely throw off his traditional loyalty to the social system with its sanctions and disciplines. His cultural inheritance renders his temperament cautious and conservative, inaccessible to unexpected stimulus. When thrown into the vortex of a virile and unfamiliar civilization, the young man is naturally in a painful dilemma, with his loyalty divided between the attractions of "an agitating social and political institution charged with feeling and aspiration" and the convictions of the moral certainty of his social philosophy and racial tradition. This tension in thought produced by the dual appeal of Western influence and of Indian culture must account for the manifestations of zeal and energy for the social institutions of Europe on the part of some young men, more self-confident than their compatriots, and for the grievances and humiliations of others whose response to the new surroundings must be "involuntary rather than deliberate". Though these two types of young men cannot be presumed to be entirely insensible to some of the influences of the Western political and social ideals, it is too much to suppose that they are fully conscious of their deeper significance to the traditions of Indian cultural institutions and the philosophy of ultimate human values, which they have imbibed from infancy. It is true that the eddying currents of Western civilization are gradually overflowing the backwaters of Indian life and thought, and if India becomes submerged and ultimately forfeits her power of rolling back all the flotsam and jetsam brought by these currents, she must inevitably lose her ancient character, as the deliverer of the message of peace, harmony and understanding. Who would be responsible for stripping her of this power?

"Is it just possible" Doremus Jessup sighed, "that the most vigorous and boldest idealists have been the worst enemies of human progress, instead of its greatest creators? Possible that plain men with the humble trait of minding their own business will rank higher in the heavenly hierarchy than all the plumed souls who have shoved their way in among the masses and insisted on saving them."

Parasitism in Insects

By K. B. Lal, M.Sc., Ph.D., F.R.E.S.
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Introduction

MOST animals have their natural enemies which are usually grouped into two classes: predators and parasites. The former only attack for food and after feeding for a short while on their victims, which are usually killed in the process, give them up. The latter may attack for egg-laying as well as for food and their association with their victims is of a more permanent nature and generally lasts till the parasite reaches the adult stage. The distinction between predators and parasites is sometimes arbitrary and many workers often regard them as merely two extreme examples of a type of life in which one insect lives at the expense of another.

Parasitism is more common among insects than perhaps in any other group of the animal kingdom with the exception of the helminth worms. In its simplest form one insect parasitises another which is not a parasite (primary parasitism). When the attacked insect is itself already a parasite the phenomenon is known as hyper- or secondary parasitism. Sometimes two or more species of insects attack the same host simultaneously leading to multiple parasitism or, according to some authors, superparasitism, though the latter term is better restricted to cases where the attacking insects belong to the same species. Most dipterous and hymenopterous parasites often eventually destroy their hosts and, on this account, are termed by some authors as 'parasitoids' to distinguish them from other parasites whose presence to their hosts usually does not prove fatal.

Origin of Parasitism

It is generally believed that insect parasites originally evolved from free living and phytophagous forms which took the first step towards a parasitic existence by living in harmless association with other animals. Later, physical proximity, habits of cannibalism, which gradually widened to include other species, a kind of rough similarity between certain plant and animal foods, such as lichens, coccids, etc., induced one insect to feed on the other. The predatory habit thus acquired was maintained so long as the predator did not find enough nourishment on one host and had to attack several of them but if the host was large enough to supply the full requirements of its enemy the necessity for changing the host vanished and a more lasting association leading to a parasitic mode of life came into existence. A border-line case is that of two micro-moths, *Zenodochium coccivorella* Ch., and *Euclemensia bassettella* Cl. which parasitise coccid hosts (*Kermes* sp.). The caterpillars of these moths each live on a single *Kermes* individual though the latter's substance is hardly adequate to sustain the parasite till it is full grown. It is conceivable that the caterpillar would have had to attack more than one host if the substance afforded by a single host was much under requirement. In other words, parasitism here is only just in advance of predatism (Balduf, 1938).

Parasitic life among Epipyropidæ, a group of small moths, seems to have evolved in an analogous manner. It is now certain that the ancestors of these moths were phytophagous and fed on plant juices as do their homopterous hosts of to-day. The epipyropid caterpillars found equally palatable food in the anal and other excretions of the homopterous insects living alongside with them, from which it was a short step to living on the bodies of the latter and not only obtain their excretions very much near at hand but also get the benefit of shelter and transport. Parasitism in Epipyropidæ, therefore, is considered to be of a very simple order, not advanced yet to the higher specialisations of efficient parasites (Balduf, *op. cit.*).

Change in feeding habit led to change in body structure. In the attacking insect certain morphological characters became unnecessary and in turn certain others were developed to suit its new requirements. The bed bug and the flea, for instance, seem to have lost their wings as a result of parasitic existence. Among bird lice the eyes are greatly reduced or even absent,

obviously because, living as they do on the cuticle and feathers of birds, they hardly need them. In many first instar hymenopterous larvæ there is complete absence or at least feeble development of the spiracles and the tracheal system and respiration is cutaneous, the blood of the host providing the necessary oxygen. An anal vesicle or caudal appendage is present in the early instar larvæ of *Exochilum, Limnerium, Dinocampus, Meteorus,* etc., which is undoubtedly respiratory in function though it later gets absorbed in the body as the larvæ develop and begin respiring by means of spiracles.

Another view regards parasites not so much the creatures of necessity as the natural result of an intelligence in insects, with predatory instincts, following up an advantage. According to this view parasitism is an achievement in which the mode of living illustrates specialisation rather than degeneration. Obviously the greater the specialisation for extracting nourishment from the host for the longest period of time the more successful is the parasite. Indeed the perfect parasite will not kill its host as by doing so it will only starve itself, and the one that would kill its host will not be so well evolved as the other that would not. Hermes (1926) cited a number of cases to show that many parasites which habitually live and breed on their hosts are not so troublesome to the latter as those that attack only occasionally. The mosquito, *Anopheles maculipennis,* which is a vector of the causative organism of malaria, is 'benign' in its bite but *Aedes dorsalis,* a wild salt marsh species, is viciously irritating, though harmless.

Some Types of Parasitism

From the standpoint of their feeding habits, parasites are divided into two categories: endoparasites, which feed inside the body of their hosts, *e.g.,* many dipterous and hymenopterous parasites, and ectoparasites which feed on but live outside the body of the host, *e.g.,* the ticks and lice of various birds and mammals and many braconid parasites of insects. Among insects Diptera and Hymenoptera provide the commonest examples of parasitism. Three families of beetles and two of moths also contain parasitic species while stylops or Strepsiptera are exclusively parasitic. Most ectoparasitic insects are drawn from the order Anoplura. In the groups just enumerated several families, *e.g.,* Cecidomyidæ, Anthomyidæ, Evanidæ, Cynipidæ, Staphylinidæ, etc., contain both predatory and parasitic species.

Parasites depend for their existence on their hosts and have, therefore, adapted themselves, in many cases very finely, to the habits and characters of the latter. Perhaps the most varied examples of adaptation are met with in the tachinid flies which include oviparous as well as larviparous species. In America the females of *Sturmia scutellata,* a parasite of the gypsy moth, lay their tiny black eggs on the foliage which are swallowed by the caterpillars and the hatching of the parasitic egg actually takes place inside the alimentary canal of the host. The females of another tachinid, *Prosena siberita* Fabr., a species widely distributed in Europe and Asia and introduced in America to control the Japanese beetle, deposit their larvæ on the soil which wander about till they find host larvæ into whose bodies they penetrate and develop. In such cases the parasitic larvæ have to be active migratory forms well adapted to seeking their hosts (Sweetman, 1936).

The majority of hymenopterous parasites, however, lay their eggs in or on the eggs, larvæ, pupæ and even adults of their hosts. Many species of Mymaridæ, Trichogrammidæ and Seclionidæ parasitise the eggs of various bugs, moths, butterflies, beetles, flies, grasshoppers, mantids, etc. One of the most important of the egg parasites, is the famous *Trichogramma minutum* (Riley), a cosmopolitan species parasitising an unusually large variety of hosts in the egg stage and employed extensively to control codling moth, moth borers of sugarcane and several other pests in various countries. Many braconids and ichneumonids parasitise the larvæ and pupæ of their hosts. *Melcha nursei Cam.,* a well-known parasite of the spotted bollworms of cotton in various parts of India, lays its eggs on the body of the host pupa by puncturing its cocoon. Parasitisation of the adult is rather less common than those of the immature stages but the braconid genera, *Perilitus* and *Dinocampus* are known to parasitise some adult beetles. An interesting case is that of a cecidomyid (*Endopsylla* sp.) in Scotland, which lays its eggs on the wings of *Psyllia mali* race

peregrina. The larvæ that hatch feed for sometime ectoparasitically on the body of the host and then bore into the abdomen near its base and develop endoparasitically till full grown when they come out of the body and pupate in the soil (Lal, 1934).

Host Selection

The number of hosts which a parasite will attack is often limited and is at times confined to only one species which means that it exercises some discrimination when out for oviposition. Parasites must select their hosts and before they can select they must find them. It seems now generally agreed that the first concern of a parasite is not so much to seek a host as the particular type of environment in which it is likely to be present and then only to look for it. In doing this the parasite restricts the field of its search and increases the chances of its coming into contact with a suitable host.

The factors that guide parasites in host finding and host selection have been subjects of great controversy and some experimentation. It was believed by Thompson and Parker (1927) that the laws underlying the problems of host relations could not be scientifically ascertained and expressed in scientific terms, a view which was refuted by Salt (1935) as a result of his work on *Trichogramma evenescens*. Salt showed that the chief criterion which guided an ovipositing female of this species in selecting its host was that of size since out of several objects selected and attacked by the parasite many were unsuitable and from which no progeny could develop. More recently Laing (1937) has analysed the factors for host selection and concluded that not only *Trichogramma* but many other parasites, *e.g., Alysia manducator,* are first attracted by the qualities of an environment irrespective of the fact whether their host happens to be present in it or not, but within the environment itself sense of sight is their chief guiding factor. To the extent that sight helps the parasites to distinguish size Laing's conclusions may be said to agree with those of Salt.

Ullyett (1936) on the other hand, working with the chalcid, *Microplectron fuscipennis* Zett., and its tenthredinid host, *Diprion* sp., showed that this parasite could exercise a high degree of discrimination between healthy hosts and those already containing well-grown parasitic larvæ, although a parasitised host merely harbouring an egg of the parasite was distinguished. This discrimination was ascribed to the presence or absence of movements of the host larva and it was also inferred that a definite proportion of every host population was not subject to random oviposition. Ullyett, therefore, concluded that "a wholly mechanistic view of host selection is untenable and that the underlying basis of behaviour is of a psychological nature".

Effects of Parasitism on Hosts and Parasites

The presence of a parasite is undoubtedly inimical to its host but the extent of this injury varies widely, from simple annoyance to death. Most of the biting lice live upon their bird hosts for a long time merely causing deep irritation to their skin by the scratching action of the claws of their feet. Some parasites, although they themselves do not prove fatal to their hosts directly, may cause the latter's death by transmitting various disease germs. The louse, *Pediculus humanus* L., is known to transmit typhus and relapsing fevers and some other human diseases through punctures of the skin made with its mouth parts or by its infected excreta coming in contact with an abrasion on the skin. Many Ichneumonidæ, Bethylidæ, Scollidæ, Tiphiidæ, etc., habitually sting and paralyse their hosts before ovipositing in them and in the process even kill them. *Tiphia popilliavora* Roh., a parasite of the grub of the Japanese beetle, stings its victim so many times before egg-laying that the latter dies through mere mechanical injury.

Usually some distortion or change of colouration of the host occurs sooner or later after parasitisation. Psyllid nymphs, as a rule, when parasitised by encyrtids turn brown and become bloated. Many aphids, *e.g., Aphis rumicis,* when parasitised by species of *Pachyneuron* and other chalcidoids, turn black. The effects of parasitisation of several hymenopterous and homopterous genera by stylops are now well known and in many cases are so characteristic as to be known by the special name of 'stylopisation'. In the bee genus *Andrena* some curious results follow parasitisation by the female stylops. The 'stylopised' bee has a more globular abdomen and a shorter

head: in addition certain secondary sexual characters are also affected. The parasitised female bees have the pollen collecting apparatus so reduced that their hind legs resemble those of the males, the sting is shortened in size and often the yellow colouration of the male is acquired. In the male the copulatory apparatus suffers atrophy. Indeed in *Andrena* the changes due to 'stylopisation' have been regarded not merely degenerative but as inversions of development in which the female acquires certain characters of the male and *vice versa*.

Several cases are on record in which the rate of development of a host insect is accelerated by the presence of a parasite 'Stylopised' insects of several species of *Andrena* (*A. crawfordi*, Pierce, 1909; *A. wilkella*, Perkins, 1918) were shown to emerge earlier than the healthy bees. According to Alston (1920) the larvæ of the blow-fly, *Calliphora erythrocephala*, were stimulated to immediate pupation if attacked by the braconid, *Alysia manducator*. The larvæ of a chloropid fiy, *Lipara lucens* Meigen, which are full grown in autumn, normally hibernate in winter and pupate in the following May but pupation may ensue in autumn if the larvæ are parasitised by the braconid, *Polemon liparœ* Giraud (Varley and Butler, 1933). In a general discussion of this phenomenon the authors conclude that the effect of parasitisation in such cases is to provide a shock which can be and has been simulated mechanically and in nature with very much the same results.

The above instances have dealt with the effect of parasites on their hosts. Recently Salt (1937) has recorded the case of a host affecting its parasite. The eggs of *Sialis lutaria* (Neuroptera) are parasitised by *Trichogramma semblidis*, the males of which occur in two forms, both of which are equally large but differ in important characters and are not connected by intermediates. Rearing experiments with four different hosts, including the original one, showed that males bred from the original host were of apterous form while those reared from the other three (all moths) were of winged form. According to the author the dimorphism has a nutritional basis but it is not the amount but the kind of food that produces the difference. Here, therefore, it is the host that determines the character of the emerging parasite.

Hyperparasitism

Primary parasites are about as liable to parasitisation by their insect enemies as the hosts they themselves attack but while secondary parasitism is quite common parasitism of a higher order, tertiary, quaternary, etc., is progressively rare. It seems that sometimes insects come to attack primary parasites but alight upon a secondary parasite and find themselves actually in the role of a tertiary parasite. It is also doubtful if some cases of tertiary parasitism are not merely cases of multiple parasitism in which several parasites try to live in the same host. In this struggle some of the parasites are naturally killed and the survivors, though they themselves are not directly responsible for the deaths, get the appearance of secondary parasites. The prevalence of this competitive parasitism creates considerable confusion in the determination of the exact status of a parasite, a matter of great significance in the biological control of insect pests.

The extent of hyperparasitism, a term which may include all grades of parasitism higher than primary, though some authors restrict it only to secondary parasitism, in nature depends largely upon the degree and the period of exposure or concealment chiefly of the primary parasites, specially in the cocoon stage. In general hyperparasites are not as discriminating in the selection of their hosts as primary parasites and this fact accounts for the great abundance of hyperparasitism in the field. Thus even one species, *Perilampus hyalinus*, may parasitise hosts belonging to groups Tachinidæ, Braconidæ, Ichneumonidæ, and Chalcidoidea.

Conclusion

The problems of parasitism in insects are important in relation to several branches of natural history and in applied entomology. Their study sometimes leads to interesting conclusions about the phylogeny of host insects. Similar parasites, at present, attacking very divergent groups of insects are taken, along with other evidence, to denote a common ancestry for the latter. Questions of multiple and hyperparasitism furnish interesting material for the study of insect

populations while the interrelationships between hosts and parasites provide valuable aid in the understanding of insect behaviour. In protecting crops and domestic animals from their pests, both insect and weed, the method of controlling the latter by means of their natural enemies is coming to the fore every day but the very complex problems involved make it essential to study and thoroughly understand the parasite in relation to its hosts and environments. Few groups of insects seem destined to be more important than those collectively grouped as parasites.

ACKNOWLEDGMENT

The manuscript of this paper has been kindly read through by Dr. Hem Singh Pruthi, Imperial Entomologist, and my thanks are due to him for his very helpful criticism on several points.

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Nicotine and Citric Acid Content in the Progeny of the Allopolyploid Hybrid *Nicotiana rustica* L. × *N. glauca* Grah.

By Dontcho Kostoff

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ALLOPOLYPLOID di-*rustica*—di-*glauca* originated by chromosome duplication in the first generation of the hybrid *Nicotiana rustica* ($n = 24$) × *N. glauca* ($n = 12$).[1] It had 72 somatic chromosomes and was partially fertile and dwarf in size, while the F_1-hybrid developed normally and was self-sterile.[1] In studying the procedure of the meiotic processes in the allopolyploid di-*rustica*—di-*glauca* hybrid, I found quite often the appearance of multivalent chromosomes (quadrivalents and trivalents with univalents) during the first meiosis due to auto- and allosyndesis. I shall mention here that allosyndesis between *glauca* and *rustica* chromosomes was also observed in the F_1-hybrids which formed a variable number of bivalents (sometimes until 12), some of them being heteromorphic. The appearance of univalents and rarely one bivalent in *N. rustica* ($n = 24$) haploid[2] indicates that bivalents in F_1-*rustica* × *glauca* result from allosyndetic pairing, *i.e.*, from chiasma formation between *N. rustica* (r) and *N. glauca* (g) chromosomes.

Allo- and autosyndetic chiasmata (r—r—g—g) of the multivalents formed among *N. glauca* and *N. rustica* chromosomes in the allopolyploid di-*rustica*—di-*glauca* are responsible for the formation of unequal gametes. The inconsistency, *i.e.*, the segregations in the subsequent generations of this allopolyploid is consequently due to the exchange of parts between *N. rustica* and *N. glauca* chromosomes in the multivalent groups as it was clearly shown for the allopolyploid *N. glauca—Langsdorffii*.[3]

The progeny of the dwarf allopolyploid *N. rustica-glauca* differed enormously in respect to their morphological, physiological and biochemical characters. In the second, third and fourth allopolyploid generation (A_2, A_3, A_4) there were dwarfs (about 40 cm.), giants (about 250 cm.), and all transitional degrees between these two extremes. Similar amplitudes of variations were observed in the leaf sizes and shapes, the flower sizes and shapes and the vegetation periods, the latter and the length of the petioles showing even a transgressive segregation in respect to those of the parental forms. There were segregates that developed very rapidly and formed a larger amount of green mass (leaves and stems), than the parental species *N. glauca* and *N. rustica*. A more detailed description of their morphology and cytogenetic behaviour will be given elsewhere. I shall call attention here to the alkaloid and citric acid

content of some plants of the fourth generation (A_4) of the allopolyploid di-*rustica*—di-*glauca*, grown in 1937.†

The data given in Table I show that the original species *N. rustica* contains alkaloid, nicotine, while the other parental species both alkaloids, nicotine and anabasine. The studies by the collaborators of the Tobacco Institute[4] showed that in species crosses when one of them has nicotine, and the other anabasine, F_1-hybrids contain—as a rule—anabasine. The behaviour of the

TABLE 1

Alkaloid and citric acid contents of the amphidiploid, Nicotiana rustica × N. glauca *and of the original species*

No.	Plants	Alkaloid content: per cent.			Citric acid content per cent.
		Nicotine	Anabasine	Total alkaloid content per cent.	
1	*Nicotiana rustica*	2·059	0	2·059	5·595
2	*Nicotiana glauca*	0	0·837	0·837	3·036
	Amphidiploid plants				
	N. rustica × *N. glauca*				
3	75006 — 1	0	1·423	1·423	2·428
4	75006 — 100	0	1·232	1·232	—*
5	75006 — 101	—	—	—	4·967
6	75006 — 102	—	—	—	3·025
7	75006 — 103	0	0·971	0·971	4·679
8	75006 — 104	0	1·449	1·449	3·263
9	75006 — 105	0	1·182	1·182	4·397
10	75006 — 106	0	1·088	1·088	3·572
11	75006 — 107	0	1·395	1·395	4·447
12	75006 — 108	0·093	0·509	0·602	2·937
13	75006 — 109	0	0·753	0·753	3·431
14	75006 — 111	0	1·204	1·204	3·529
15	75006 — A	0	1·386	1·386	1·319
16	75006 — B	0	1·986	1·986	1·675
17	75006 — E	—	—	—	2·081

* — Denotes undetermined.

N. glauca and all allopolyploids contain alkaloid anabasine with a single exception, namely plant No. 75006–108, which contains

† The determination of the citric acid and alkaloid contents were carried out in the Biochemical Laboratory of the Institute of Genetics under the direction of Prof. A. A. Schmuck for whom I wish to express my gratitude.

progeny of our allopolyploid confirms this rule. In crossing F_1 – *N. rustica* × *N. glauca* back to *N. rustica* and selfing the back crosses I obtained very abundant material which was given to N. I. Zhukov for further study. I grew in 1937 a few families of it and the results of the chemical analysis of

some plants are given in Table II. The data show that they contain both alkaloids, nicotine and anabasine. Large number of analyses carried out by Zhukov (in the press and unpublished) upon the same material during two generations showed that plants having anabasine segregate into (1) plants with anabasine and (2) plants with both anabasine and nicotine, while plants having both anabasine and nicotine never give rise to plants only with anabasine. Such a behaviour of the alkaloids suggests that the allopolyploid No. 75006—108 is a segregate resulting from crossing-over between *glauca* and *rustica* chromosomes carrying the gene or genes that are involved in the formation of the alkaloids. This question will be thoroughly discussed elsewhere.

A *N. rustica*-like segregate from the back cross (*N. rustica* × *N. glauca*) × *N. rustica* contained only anabasine without nicotine. *This is a case when biochemical character is transmitted from one species on the background of another one following interspecific hybridization.*

In studying the citric acid content (the plants contain it in form of salts) in the allopolyploid segregates (Table I) it was found that they have very different contents of this substance, although they grew under identical environmental conditions together with the parental species. Segregate No. 75006-A had, for example, 1·319 per cent. citric acid, segregate No. 75006—101 had 4·967 per cent., while the parental forms had, *N. rustica* 5·595 per cent. and *N. glauca* 3·036 per cent.

Allopolyploid *N. rustica-glauca* is an interesting plant from the agricultural point of view, because it segregates forms with larger amount of anabasine (1·986, 1·449, 1·395 per cent., etc.) than the parental species *N. glauca* which, when grown in the same environmental conditions, contained only 0·837 per cent. At the same time the offsprings contain a relatively large amount of citric acid. Further generations of some of the offsprings should give the possibility of selecting forms with larger content of anabasine and citric acid. The populations produced from the back-crosses can be used for the same purpose. It should be also mentioned here that anabasine content can be increased about three times after decapitation as the analysis by Zhukov has shown.

Alkaloid anabasine is one of the most important insecticides. It is being produced now from the *Anabasis aphylla* which grows wild. This plant contains about 1·3–2·0 per cent. anabasine. Young parts of the plant contain up to 2·53 per cent. anabasine, but the production of anabasine from *A. aphylla* is insufficient to cover the requirements of this chemical. Some of the allopolyploid segregates, on the other hand,

TABLE II

Alkaloid and citric acid contents in some plants of the $F_{3/4}$ *generation of the back-cross* (N. rustica × N. glauca) × N. rustica

No.	$F_{3/4}$ of the back-cross (*N. rustica* × *glauca*) × *N. rustica*	Nicotine per cent.	Anabasine per cent.	Total alkaloid content per cent.	Citric acid per cent.
1	75115 — 1	0·927	0·403	1·330	—*
2	75133 c — 2	—	—	—	2·554
3	75133 c — 3	0·654	0·648	1·302	4·856
4	75133 c — 5	1·140	0·502	1·642	5·118
5	75133 c — 6	0·645	0·718	1·363	—
6	75134 c — 1	—	—	—	3·964
7	*Nicotiana glauca*	0	0·837	0·837	3·036
8	*Nicotana rustica*	2·059	0	2·059	5·595

* — denotes undetermined.

grow very rapidly and give a very large amount of green mass when grown in suitable environmental conditions.

Considering all these facts, I think that our allopolyploid *N. rustica—N. glauca,* as well as the back-crosses and other hybrids between *N. rustica* and *N. glauca* that are studied now in the All-Union Tobacco Institute by N. I. Zhukov might answer the demands of the industry in a short time if the plant-breeding work with these plants is put on a somewhat larger scale.

I shall also mention here that most of the allopolyploid segregates are from perennial plants like *N. glauca,* and the annual parent, *N. rustica.* In autumn 1938, when the temperature dropped at night to −5° C., the leaves of *N. glauca* were severely injured, but the plants were not killed. The same reaction occurred with most of the allopolyploid segregates. A few segregates were, however, less injured than *N. glauca* plant. A single segregate was not affected by −5° C. All *N. rustica* plants were killed by a temperature of −3° C. Amphidiploids *N. rustica* × *tabacum* and *N. glauca* × *Langsdorffii* behaved in a similar way. Autotetraploid plants of *Solanum Lycopersicum* were also more resistant to cold than their diploid forms. Preliminary observations show that a series of polyploid plants are more cold-resistant than their original diploids. This new character permits the polyploid forms to occupy more nordic areas than their original diploids. It seems very probable that polyploidy will help the plant breeders to move some of the existing cultivated varieties and even some forest plants towards more nordic regions by doubling their chromosome numbers.

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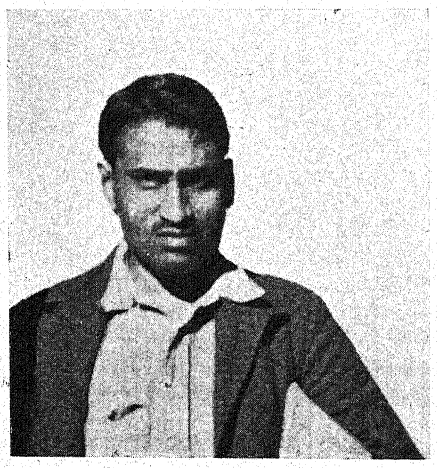
OBITUARY

Ravindra Nath Misra (1912–38)

ON the 9th of December 1938, a tragic accident removed from our midst Ravindra Nath Misra, Research Fellow in Botany in the University of Lucknow. Mr. Misra died of burns received by the bursting on him of a flask of alcohol which caught fire while he was trying to light a spirit lamp. He passed away very young, when he was hardly twenty-six and was beginning to carve out for himself a brilliant career in botanical research. Only a few days before his death he was awarded the *Ruchi Ram Sahni Prize* for 1938 for the best research work in Botany.



Ravindra Nath Misra

Mr. Misra became Research Scholar on obtaining his M.Sc. degree in 1936. By himself and in collaboration with Dr. S. K. Pande, he carried out investigations on the liver-worts of this country. He was collaborating with Dr. Pande in the production of a series of monographs—"Studies in Indian Hepaticæ".

Mr. Misra had a tremendous love for mountaineering. He organised several expeditions from the Botany Department of the Lucknow University to far off places in the Himalayas and brought back with him valuable plant collections.

It is difficult to believe that a promising career like his could be cut short so cruelly and with such gasping suddenness. As a man, he had rare qualities: frank, straightforward and untouched by mannerisms. His is a loss to Indian Botany, not only on account of what he could achieve during his butterfly existence, but also because of what he would have achieved if he had been spared. Among his friends he has left a void which cannot easily be filled.

RAJENDRA VARMA SITHOLEY.

REVIEWS

Theoretical Hydrodynamics. By L. M. Milne-Thomson. (MacMillan, Ltd., London), 1938. Pp. 552 + xxii. Price 31*sh.* 6*d.*

Text-books on hydrodynamics are none too common and the appearance of a new one is to be heartily welcomed. The object of the present book, as stated in the Preface, is "to give a thorough, clear and methodical introductory exposition of the mathematical theory of fluid motion which will be useful in applications to both hydrodynamics and aerodynamics". In reviewing a book of this kind one is led naturally to compare it with the only other English text-book on the subject, Ramsey's well-known *Hydromechanics*, Part II, which has served successive generations of students for over quarter of a century. The range covered by both the books is very nearly the same. Apart from differences in the treatment of individual topics, the main point of difference consists in the consistent use of vector methods, which was deliberately avoided in the older text-book. In the present book, after an introductory chapter devoted to the Bernoulli equation and its applications, vectors are introduced and explained in the second chapter and the leading formulæ of vector analysis are developed. The treatment of two-dimensional problems requires the use of the theory of analytic functions and conformal transformations, to which, therefore, is devoted a separate chapter. Next follow seven chapters devoted to the application of conformal mapping to a variety of problems of two-dimensional fluid motion covering standard topics such as sources, sinks and images, flow past cylinders, the theorems of Blasius and of Kutta-Joukowski, the impact of a stream on a lamina and also a few others. Of these latter, special mention may be made of the account of the elementary theory of the aerofoil (which gets a chapter for itself), the extended form of Blasius' theorem, various cases of impinging jets and an account of Levi-Civita's general method of determining the flow past an obstacle, including a derivation of Levi-Civita's elegant expressions for the drag and lift. The remaining chapters devoted to vortex motion, waves, the motion of solids in liquids, etc., need no separate mention. The concluding chapter on viscosity includes brief discussions of Prandtl's hypothesis of the boundary layer and Oseen's linearised equations for slow motions. The value of the book is considerably enhanced by the relatively large number of diagrams illustrating the disposition of the streamlines in the various problems and more especially by the beautiful and striking photographs illustrating the formation of vortices in the motion of an aerofoil and of the Karman trail. Following the best English tradition, large collections of examples are given at the ends of the chapters and should be of invaluable aid both to the student seeking to become a past-master in the tricks of the trade as well as to the examiner hunting for fresh traps to catch the inexpert and the unwary. Of course, the collections naturally include also many problems of greater intrinsic importance. A very short historical sketch, in the form of a list of the leading names (with dates) associated with the progress of the subject, is given at the beginning of the book. It is not a little surprising to find that no mention is here made of Lord Kelvin, whose remarkable researches have contributed so largely to the development of the subject.

As already stated, vector methods are used throughout. It is largely a matter of individual taste what notation one prefers and it is no doubt true that the vector notation contributes to economy in the writing of formulæ, but the author's claim that it "simplifies and illumines" the whole subject seems to the reviewer to be a little exaggerated. Vector analysis is more adapted to give neat general formulæ than to the working out of individual problems; indeed the author has himself remarked (p. 39): "as soon as a problem becomes sufficiently particularised to yield numerical results, it will be found that recourse to co-ordinates will be advisable." The trouble is that in hydrodynamics, we are nearly always interested in such particular problems and relatively rarely in general theory, unlike in electro-magnetic theory for instance, where we have a large body of general theory to which the vector method contributes both elegance and simplicity.

This review began with a comparison of the present text-book with another and it

is, perhaps, not inappropriate that it should conclude by referring to a last point of difference between them, namely, the difference in price. The rather high price of the present book must inevitably make it inaccessible to many and prevent a good text-book from being used as widely as it deserves to be. K. S. K. IYENGAR.

Advanced Analytic Geometry. By Alan D. Campbell. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1938. Pp. x + 310. Price 20*sh.*

The object of this book is to give an analytical presentation of projective plane geometry. It is divided into two parts, Affine and General Geometry, treated in the first eight and the last ten chapters respectively.

The first six chapters deal mostly with some of the tools of affine analytic projective geometry, *e.g.*, frames of reference, affine linear transformation of co-ordinates, groups of linear transformations and their associated geometries, and imaginary elements in geometry, *viz.*, points, lines and curves at infinity. The seventh and eighth chapters consider the geometric material on which these tools are used, *viz.*, conics, systems of conics and *n*th degree curves.

The second part gives an introduction to the general projective plane geometry. The triangle of reference and homogeneous co-ordinates are studied in detail. The line at infinity is used to discuss various types of conics. Homogeneous and non-homogeneous line-co-ordinates are defined and applied to conics and other *n*-ics. Plane duality has been studied both from the synthetic and analytic standpoints. There is a lengthy chapter on general projective transformations in point- and line-co-ordinates, which are then applied to discuss the collineations, homologies, elations, projectivities, involutions, cross-ratio, harmonic ranges and pencils, correlations and poles and polars. The last four chapters deal with some projective properties of conics, complete quadrangles, *n*-ics and linear families of conics.

The book is profusely illustrated, and contains examples and exercises after each section. Matrices and determinants are used freely, and the style itself is very terse. This has made it possible for the author to compass a large amount of material within 300 pages. The reference system is rather defective. The equations are numbered from 1 to 138, and there is no indication of the section or chapter at the head of the pages, so that one has to waste a lot of time in finding a particular equation to which reference is made in the text.

The book would serve as an excellent introduction to analytical projective geometry, and is to be strongly recommended. M. R. S.

Co-ordinate Solid Geometry. By Robert J. T. Bell. (Macmillan & Co., London), 1938. Pp. xiii + 175 + xliii. Price 7*sh.* 6*d.*

Professor Bell's *Elementary Treatise on Co-ordinate Geometry of Three Dimensions* has been the popular text-book on the subject in Indian and British Universities. The book under review is a reprint of the first nine chapters of the older book, and provides an introductory course on the plane, straight line, and the standard conicoids. Professor Bell has taken advantage of this opportunity to make some improvements, and has added an Appendix giving simplified methods for the distance from a point to a plane, constants in the equation of a line leading to line co-ordinates, section of a surface by a given plane, cone with a given curve as base, generators of the hyperboloid and reduction of the general equation of the second degree. The inclusion of more miscellaneous examples has enhanced the utility of the book.

In the opinion of the reviewer, the chapter on the Sphere is too brief. It could profitably have contained an account of the polar planes and lines, locus of parallel chords, etc., leading on to the corresponding account for the conicoids. The cylinder also should not have been altogether neglected.

However, the book is admirably suited for beginners, and would be welcome to students and teachers alike. The price seems to be rather too high for a book of this kind. M. R. S.

A Course in Chemical Spectroscopy. By H. W. Thompson. (The Clarendon Press, Oxford), 1938. Pp. vi + 86. Price 6*sh.*

Recent rapid and significant developments in the theories of spectroscopy have made the spectroscopic method of tackling problems in science one of the most useful and important both in the pure and in the applied branches. An acquaintance, therefore,

with the principles and practice of spectroscopy, is an essential equipment for every student graduating in chemistry and physics.

This little and extremely well got-up book sets out to meet in a very elegant manner this need. In fact, it is based upon a laboratory course in chemical spectroscopy recently introduced at Oxford. Eight experiments in all, have been selected for description, three of them relating to the spectra of atoms, and the rest to the electronic-banded, absorption, and infra-red spectra of molecules. A brief account of the relevant theories is given in the beginning for each of the above experiments. In order to help those who do not possess the full laboratory facilities, photographs of spectra are included, so that problems can still be followed and the calculations made.

In the opinion of the reviewer, one more experiment on the Raman spectra ought to have been included in this book, particularly as this easily takes a rank among those of "chemical importance", a basis on which the author admits the experiments described have been chosen.

We heartily recommend this book for purchase by everybody interested. Its low price should be an additional commending feature for all Honours students in chemistry and physics. M. A. G. RAU.

The Amplification and Distribution of Sound. By A. E. Greenlees. (Chapman & Hall, Ltd., London), 1938. Pp. 254. Price 10*s.* 6*d.* net.

The lay-out, maintenance and operation of sound amplifying equipment for public address systems, ball-rooms, theatres and other needs of a like nature involve a knowledge of a special branch of Radio and Electrical Engineering. Information of this nature is not always available in a single volume. Hence, this little book dealing, in a fairly comprehensive way, with the specifications and lay-out of amplifying equipment with just the necessary calculations for its proper design, is a useful addition to literature on this subject.

The book under review opens with an introductory chapter dealing with the fundamental formulæ of Electrical Engineering, with simple calculations to illustrate their practical applications.

The chapter dealing with the design of chokes and transformers used in power amplifiers, although not exhaustive, is quite adequate for all practical purposes.

The portion dealing with amplifiers could have been more elaborate. Although the author has not failed to touch on the more important systems of power amplification, one feels that a little discussion of the relative merits of different systems could have helped the practical designer to pick and choose for his individual requirements.

The details of construction and performance of different types of microphones with their individual merits for a given type of work, are quite interesting and informative.

Considering the important rôle played by building materials, and the geometry of buildings in determining the reverberation time, which has an important bearing on the clarity of amplified speech projected in a given enclosure, it is rather surprising that a book dealing with the distribution of sound should not have given more importance to this aspect. A few pages devoted to the calculation of reverberation period of halls and the coefficient of absorption of materials used in building construction should have made the book more comprehensive and complete.

The author has succeeded in making the book useful for the practical man, who will find in it sufficient material to help him in the lay-out of amplifying equipment. The get-up is of a high order, the illustrations and diagrams are clear and to the point.

C. C.

Vitamins and Vitamin Deficiencies. By Dr. Leslie Harris. Vol. I. *Historical and Introductory,* Vitamin B_1 and Beri-Beri. (J. A. Churchill, Ltd., London), 1938. Pp. xiv + 204.

The last few years have seen rapid and fundamental advances in our knowledge about the vitamins. The chemical nature of the more important of them has been revealed, rapid and accurate chemical or physical methods of assay have been discovered, and considerable insight has been gained into their function in the animal organism. The importance of this advancing knowledge has been further enhanced by its increasing application in practical problems of health and disease. At the present time the subject has by far out-stepped the scope of the many earlier popular and semi-popular books. The books which summarised the results of scientific research in this field,

for example the monograph published by *The Medical Research Council* of Great Britain, and another by Sherman and Smith published by *The American Chemical Society,* have grown rapidly out of date. There was never more urgent need than to-day, of a detailed summing up of the knowledge acquired by modern research in this field.

The literature on this subject is exceedingly voluminous. An earlier estimate put down the output of papers during one year alone, at approximately one thousand, or about three new papers every day. This intense research activity has continued for over thirty years. While each paper represents some advance in knowledge, the evidence presented is sometimes contradictory. The task of proper co-ordination and summing up of scientific facts scattered in this vast literature, and of sifting out the essential from the non-essential, and the reliable from the unreliable, is indeed formidable. It can be performed in an adequate manner, by one who is not only deeply versed in the whole of the literature, but also has wide experience of research to be able to appraise properly the work of others.

It is highly gratifying to find that a person of Dr. Harris's wide outlook and experience in this field has undertaken this task. Dr. Harris has planned a series of seven volumes on 'Vitamins and Vitamin Deficiencies'. Volume I, which has just been published covers the Historical Introduction, Vitamin B_1 and Beri-Beri. The other six volumes which are also ready, and are to be published shortly, will deal with the other factors in the order in which they were investigated experimentally.

The Historical Introduction is covered by the first two chapters, which within the campus of only thirty-three pages, reviews in a comprehensive manner the intriguing story of the discovery of vitamins. This review shows evidence of intensive research and appraisement of the work of pioneers and as Sir Frederick Gowland Hopkins says in the Foreword 'it is perhaps the fairest account of the pioneer labours that has yet been written'. The other three chapters in the book are devoted to vitamin B_1 and vitamin B_1 deficiency, embracing all the different aspects of the subject—chemical, physiological as well as clinical. These chapters represent as the first two, the most comprehensive but concise summing up of the essential knowledge on the subject. Dr. Harris has the natural gift for the co-ordination of heterogeneous scientific facts of stating them clearly, correctly and yet concisely. In this work Dr. Harris has brought into play his extraordinary gift and the result is a book of exceptional value. At the end of each chapter there is a complete and up-to-date bibliography.

Dr. Harris's book will be welcomed alike by students, teachers and research workers. It is of special value to students and teachers, because within the campus of a relatively few pages a full and up-to-date knowledge of the subject is presented in a simple and lucid manner. To research workers, in this book, will be available a comprehensive synopsis of the essential facts with complete references to original literature. The other features of the book are all that can be desired. The publication of the other volumes will be looked forward to with great interest. B. AHMAD.

Dia- et Paramagnétisme et Structure de la Matière. Par B. Cabrera. (Actualités Scientifiques et Industrielles, No. 562. Hermann & Cie, Paris), 1937. Pp. 76. Price 20 *fr.*

In this volume the author has briefly summarised the results of recent magnetic research in so far as it has served to elucidate the structure of matter, with special reference to the contributions of the author and his collaborators in the field. The fundamentals of the configurations of atoms and their significance in magnetic theory are dealt with in an introductory chapter and the two remaining chapters are concerned with dia- and paramagnetism respectively. After a brief outline of Langevin's theory and the law of additivity of Pascal the author has discussed in detail the constitution of water as revealed by magnetic measurements. There is also a clear account of the law of additivity as applied to the alcohols $H(CH_2)_n OH$ from which the susceptibilities of H, OH and CH_2 are derived. The outstanding achievement in paramagnetic theory in recent years has been the deduction of the magnetic moments of the ions of the paramagnetic elements by the application of spectroscopic theory. Although in the case of the rare earth elements fairly satisfactory agreement between theory

and experiment has been achieved, the discrepancies are considerable in the case of the iron group of elements. This aspect is discussed with the help of curves showing the variation of $\sqrt{C_m}$ as a function of Z for the various paramagnetic ions and the disagreements between theory and experiment are emphasised. The interesting properties of the palladium and platinum groups of elements and the interpretation of their feeble magnetic moments are also lucidly explained. The book is on the whole, a useful résume of some of the most important aspects of dia- and paramagnetism in relation to structure. Attention may be drawn to some minor typographical errors such as "e^2" *instead of* "c^2" in the expressions for $\vec{\mu}_a$ and $\vec{\mu}_A$ on page 15; "Bhor" for "Bohr" on page 36, line 11. P. N.

Essai sur l'unicité des sciences mathematiques dans leur developpment actuel. By Albert Lautman. (Actualités Scientifiques et Industrielles, No. 589. Hermann & Cie, Paris), 1938. Pp. 58. Price 15 *fr.*

The origin of this very interesting essay is no less interesting. In the Preface to his well-known book on Quantum Mechanics, Weyl drew a distinction between two different and, according to him, opposed trends in the development of mathematics—between what may be called the "classical" and the "modern". In the first, the basic idea is that of 'number' or 'magnitude' and in the second, that of 'structure' and 'form'. Under the former may be included practically the whole of nineteenth century analysis, while the modern axiomatic theories come properly under the latter. In the book under review, the author is concerned in refuting this supposed antithesis and in showing how, in the actual development of mathematics, the two methods instead of being opposed and antithetical, have actually enriched and complemented each other in building up the mighty structure of modern mathematics. This thesis is illustrated by examples drawn from the most diversified branches of mathematics—modern algebra, integral equations, algebraic functions, differential forms, analytic functions, quantum mechanics and so on. Whether Weyl meant his statement to be taken with such uncompromising seriousness as our author does it would be difficult to say, but that need not prevent us from enjoying this delightful essay with its surprising analogies and striking illustrations. Incidentally the author displays a familiarity with every branch of mathematics—from the most recondite results in classical analysis to the latest developments in modern mathematics—which cannot but excite admiration. When the mind is jaded out with dull routine or by concentration on specialised problems, one would wish for no better diversion than these refreshing pages.

V. R. T.

The Health of the Nation and Deficiency Diseases. By John Maberly. (Bailliere Tindall & Cox, London), 1938. Pp. xi + 118. Price 5*sh.*

This is an addition to the already long list of books on nutrition written for the general public. Unfortunately the author's accuracy and scientific judgment are not equal to his enthusiasm. Numerous errors and misstatements detract greatly from its value.

R. P.

Interpretations and Misinterpretations of Modren Physics. By Philipp Frank. (Actualités Scientifiques et Industrielles, No. 587. Hermann et Cie, Paris), 1938. Pp. 59. Price 18 *fr.*

This is an acute and penetrating analysis of the manner in which statements of the results of modern physical research are couched in such terms as lead to philosophical conclusions utterly unwarranted and unwarrantable by Physical Science. The author shows that such attempts to support pet philosophical systems by Physical Science have always been ready to make use of any vaguely apprehended scientific statements to further their own object, and successfully proves that many conclusions about questions of Fatalism or Free Will contained chiefly in popular presentations of modern Physics are based entirely on a wrong philosophical interpretation of physical theories vaguely formulated so as to contain terms susceptible to such misinterpretation. As a corrective to the biassed opinion one may form of modern science by reading such popular works (including those of Sir James Jeans) we have no hesitation in recommending the present brôchure to the attention of every thinking man who wants to have a just conception of the part to be played by physical science in shaping his attitude to the problems of life.

T. S. S.

The Botany of Field Crops*

THE study of botany is an ancient and agreeable pursuit. Wild flora were usually the centre of attention. Nature study, especially in school gardens, has rarely meant the study of the botany of familiar crops. Familiarity in this respect, as in many others, bred contempt. In horticulture the artistic impulse corrected this trend. There are sound monographs on roses, chrysanthemums, orchids and other horticultural plants. It was not till after the Great War that the value of agriculture as a science and the part that knowledge played in its improvement, were recognised. There was no time nor the necessary temperament to wait for the old age-long method of hit, miss and learn. A systematic attack was indicated as a necessity. European powers with an interest in colonial possessions strengthened their agricultural staff and there followed a world-wide awakening of interest in crops. It was otherwise with America where a modern nation was on virgin land and all experience had to be and was gained anew. The interest in crops was a live issue there, much earlier than in the Old World, that grew old in the learning of this knowledge. The first interests were on industrial crops and of these cotton figured most; it might be said to-day that cotton is the crop about which there is the greatest information. The awakening of "Native" populations and the need on the part of the settlers and conquerors to bear in mind the health and welfare of these populations with whose contentment and prosperity their welfare is bound up, broad-based the interest in crops, with the result that to-day practically on every crop, be it food or industrial, there is an endeavour to clear the ignorance concerning it. Agricultural Colleges and Institutions have sprung up in large numbers and almost every Agricultural Department of importance has an Economic Botanist in its staff. Work in Economic Botany has ramified so much that there are specialists on important crops or groups of crops.

Concurrent with this advance there has been great progress in the science of genetics. The plant world has provided handy material for the pursuit of its laws, and crops have naturally come in for their share of attention and utilization.

The ultimate result of this general interest is that during the last two decades there has been an enormous output of literature on various aspects of crop improvement. Many of these are bits of crisp information, but few of them have reached the stage of being epitomes of general knowledge in the realm of crops. In the category of single-crop knowledge will rank such publications as those of Percival on Wheat, Balls on Cotton, Copeland and Ramiah on Rice, Salaman on Potato, Barber and Earle on Sugarcane, and Copeland and Sampson on Coconut. On groups of plants there are well-known publications like those of Tanaka on Oranges, Kirtikar and Basu on Medicinal Plants, and Blatter, Hitchcock and Arber on Grasses. Recently, elaborate and well-illustrated monographs have come out and of these, Ochse's "Vegetables of the Dutch Indies", and the special publications of the New York Agricultural Experiment Station on the vegetables of New York deserve special mention. Even Kew, the stronghold of orthodox botany, has recently added an Economic Botanist to its staff and has issued a special Bulletin of Miscellaneous Information in 1936 on the Crop Plants of the British Empire. It began its specialisation in crop plants with Snowden's Classification of Cultivated Sorghums. In the complementary portion of this work, namely, the knowledge of the varieties as crops alive, the Millets Breeding Station at Coimbatore with its world-wide collection of sorghum is playing its part. Kew has next taken on hand work on cowpeas and has realised the value of live material in the elucidation of facts not entirely in the ken of herbarium specimens. The various cowpeas are being grown on typical Empire Stations so that the knowledge and understanding obtained and the basis for their classification may be full and sound.

The results of these many endeavours along many lines and on many crops all over the world have not been focussed within the limits of a single publication except

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* *Introduction to the Botany of Field Crops*, by J. M. Hector, Professor of Agricultural Botany, University of Pretoria. 2 Volumes. (Central News Agency, Ltd., Johannesburg, S. Africa), 1938. Pp. lxxvii + 1127. Price £3 10*s.* nett. per set.

in the well-known book of Robbins on *The Botany of Crop Plants*. Since Robbins wrote his book, there has been a tremendous accession to our knowledge and it is therefore very gratifying to be able to receive and review the two sumptuous volumes on *Introduction to the Botany of Field Crops* by J. M. Hector, Professor of Agricultural Botany in the University of Pretoria. It is particularly gratifying to us in India that this South African publication has devoted itself so intensively to a wide range of crops, of interest not only to Europe and America, but to Asia and Africa also. None but a professor could have the leisure and comprehension to bring together this scattered knowledge into a single publication and South Africa is a particularly eminent place from which to survey the crops of the East and the West. One of the chief sources with the help of which this gathering together was achieved is obviously the *Plant Breeding Abstracts*, a precious publication of up-to-date knowledge on crops, both Empire and foreign, the prompt publication of which we owe to the vigilance and enterprise of the Imperial Bureau of Plant Breeding and Genetics, Cambridge.

Mr. Hector is very right in his view that in dealing with crops he considered them as dynamic, and any gathering of knowledge on them tentative. This will be obvious to any worker on crops; the more intimate the contact, the greater are the revelations. There is no palling or ultimateness in this experience. One is almost tempted to say that there are always surprises in store. As with Kipling's Mason and his Palace, "The *end* is forbidden". All that a worker can say is "I too have known".

Mr. Hector has rightly utilised the extensive genetical knowledge with restraint. The place assigned to cytological approach is consistent with its present advance and rapid growth. The physiological knowledge is far from advanced and is rightly not given undue importance. The nebulous intelligence which, for want of precision in pursuit, is summarised and dismissed with the familiar words "soil and climatic conditions" awaits critical analysis and this aspect is rightly left out. In the realm of Economic Botany, the chief work at present is the reconciliation of genetics and cytology to taxonomy, and of the latter, to a rational and practical system of varietal classification. The student will be much nearer having the equipment for this task after a perusal of these volumes. In dealing with particular crops, the latest knowledge regarding them has been incorporated. Even such recent advances in the study of crops as photo-periodism, vernalisation and cyto-generic crosses, have been dealt with. There is a good Bibliography for each chapter and a comprehensive Index. A special word has to be said on the choice and fineness of the illustrations which enhance not a little the utility of the publication. In these two volumes, one on cereals and the other on non-cereals, one has a wealth of information on almost all aspects of Agricultural and General Botany with special reference to readily available common crops. Mr. Hector has done a service to all students of Agricultural Botany. These books will also prove very valuable to a wide range of workers in the botanical field and should find a place among standard books on Botany. They will prove an eye-opener to the wealth of wonder that could be obtained on things common. The volumes under review are a precious addition to the very valuable series of monographs that have figured in the South African Agricultural Series. The publishers, The Central News Agency, Ltd., Johannesburg, South Africa, are to be complimented on the excellent get-up and fine finish of the volumes.

G. N. R.

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Molecular Association in Mixtures of Acetic Acid and Acetone

In a recent publication,[1] the author reported the effect of water on the molecular constitution of acetic acid and attributed the shift of the Raman line of the C = O group of the acid towards longer frequencies at higher dilutions to a breaking up of the associated molecules into simpler ones in solution. There was no direct evidence for the formation of hydrates since such a hydration must lead to a shift towards shorter frequencies as in the case of mixtures of acetone and water in which a shift of the C = O band towards smaller frequencies was observed.[2]

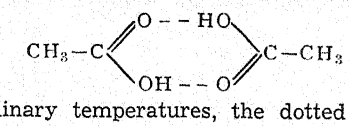
As an extension of the above work with a mixture of an associated polar liquid with another associated polar liquid, it was considered desirable to study the effect of a normal polar liquid like acetone on an associated polar liquid like acetic acid.

The C = O Raman band of pure acetic acid is a broad one with an intensity maximum at 1670 and with very feeble components at 1710, 1760. On mixing with acetone, the intensity maximum of this band shifts towards longer frequencies as in the case of dilution in water. The C – C line of acetic acid has $\Delta\nu = 893$ with a feeble component at 872 in the pure state. But in the solution in acetone, the feeble component gets more intense till it is comparable to its stronger companion and both the lines shift to smaller frequencies.

The effect of acetic acid on acetone is complimentary. As in the case of mixtures of acetone in water, methyl alcohol, and phenol,[2] the 1710 C = O line of acetone gets shifted to shorter frequencies till it gets blended with the shifted band of acetic acid, and the C – C line of acetone $\Delta\nu = 790$ shifts to longer frequencies.

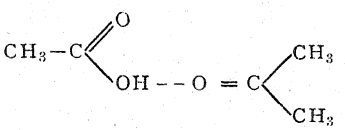
A new line at about 1760 which is not at all prominent in either of the liquids, though it is present as a very feeble component in pure acetic acid attributable to its monomer, makes its appearance in the mixtures of acetic acid and acetone. Its intensity is maximum in a 50 : 50 solution by volume while at other concentrations it persists, though with a diminished intensity.

For an explanation of these results, a consideration of the molecular constitution of these liquids in the pure state is necessary. Pure acetic acid is well known to exist in the dimeric form of the type



at ordinary temperatures, the dotted lines representing the "hydrogen bonds", or the co-ordination linkages between the 'donor' O in C = O and the 'acceptor' H in OH. Pure acetone is a normal liquid existing in its

monomeric form but the O in its C = O has strong donor properties. In the mixture of the two liquids, the shifting of the acetic acid C = O line to higher frequencies and its C — C to shorter frequencies indicates the breaking up of the associated molecules, while the shifting of the acetone C = O line to lower frequencies and its C — C line to higher frequencies indicates an association of the acetone molecule with that of the acid forming probably a complex of the form



The line 1760 may probably be due to the un-co-ordinated C = O set up in the complex so formed. The percentage of such complexes is largest in a 50 : 50 mixture and hence the increased intensity of this line at that proportion as compared to other concentrations.

On a comparison of these results with those in aqueous solutions of acetic acid, it is clear that both water and acetone have strong dissociating power on the acid molecules. But whereas, in water, its influence seems to be mainly to break up the molecules without an appreciable tendency to associate with the molecules so broken up, in acetone, there is a definite evidence for the association of the monomeric acid molecules liberated and the acetone molecules. The explanation of the differential behaviour of the two liquids lies probably in the fact that though both of them are polar, and have donor atoms, water is highly associated while the latter is not. In mixtures of associated liquids the influence seems to be a mutual dissociation of both.

The author's thanks are due to Dr. I. Ramakrishna Rao for his helpful guidance.

P. KOTESWARAM.

Andhra University,
Waltair,
February 1, 1939.

[1] *Z. fur. Physik.*, 1938, **110**, 118.

[2] Unpublished work of the author.

Distribution of Temperature and Humidity in the Upper Air over Karachi

THE kite flights made by J. H. Field in August and September 1905, were the first attempts to determine the temperature and humidity conditions in the upper air over Karachi. Although the flights were made on only 14 days and the highest flight reached 1,380 metres, valuable information was obtained[1] regarding the conditions in August and September, the chief feature discovered being, the existence of a well-marked inversion separating a lower layer of moist sea air from comparatively very dry air above.

Since June 1927, the R.A.F. at Karachi (Drigh Road) have taken observations of dry and wet bulb temperature and pressure at definite altimeter heights on aeroplane flights and provided meteorological information of great value. The data obtained after January 1929, have been published in the 'Upper Air Data' volumes of the India Meteorological Department. The published data of the seven years, 1929–35, have been recently analysed and discussed in *Indian Meteorological Department Scientific Notes*,[2] in which diagrams showing the average distribution of temperature and humidity during the year up to 3 Kms. (or about 10,000 feet) have been given. These diagrams were prepared from the mean values of data tabulated for every ½ Km. height and do not show quite clearly certain peculiarities of the temperature and humidity distribution below 6,000 feet. With a view to bring out more clearly these peculiarities and also to extend the diagrams to 5 Kms. (or about 16,000 feet) up to which height, the aeroplane meteorological flights extended after January 1936, new diagrams have been drawn (Figs. 1 and 2) based on the data for 1936 and 1937, utilising temperature and humidity values tabulated for every 0·25 Km. height.

The temperature diagram (Fig. 1) shows isotherms drawn at intervals of 4° F. and the humidity diagram (Fig. 2) shows lines of equal relative humidity drawn at intervals of 10 per cent. relative humidity. The average heights of base of inversion (dash and dot line) and

of top of inversion (dash and two dots line) during April to September are also shown in the temperature diagram. An examination of

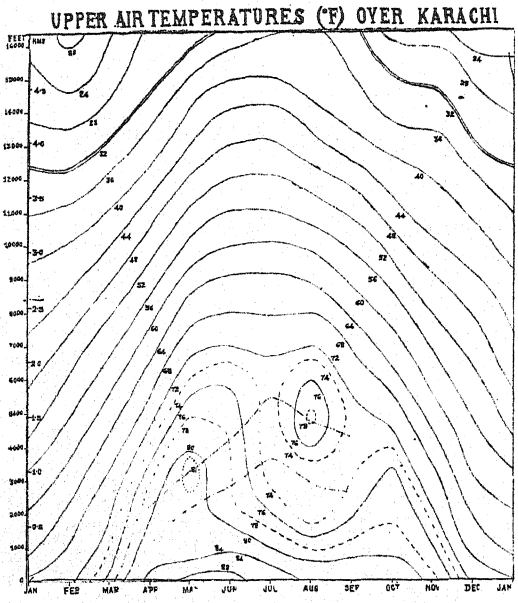


FIG. 1

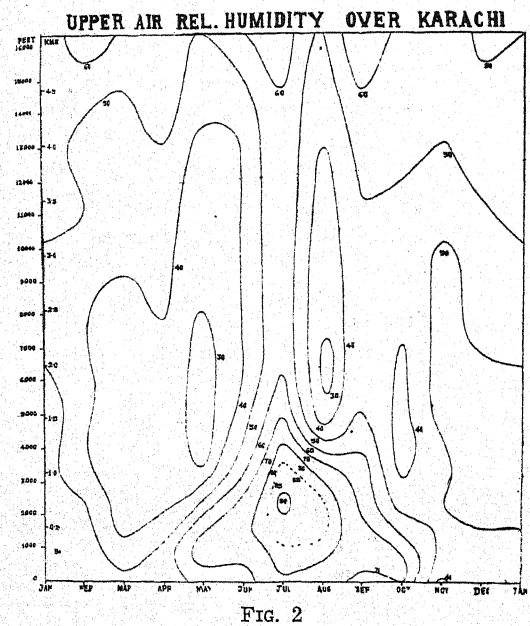


FIG. 2

the diagrams reveals some important features which are mentioned below.

(i) The 32° F. isotherm (double line) shows that the freezing temperature occurs at a height of 12,000 to 13,000 feet in the winter months—December to March—and at higher levels in the rest of the year. It occurs at heights of over 16,000 feet in June to September. The above information is of interest in connection with the question of ice-formation on aeroplanes. Ice-formation is known to occur in regions where the temperature is below the freezing point of water and the air saturated with water in the liquid state as in clouds or rain. At the heights at which freezing temperature (or lower temperature) occurs over Karachi the air is generally only about half saturated, so that in general, ice-formation does not appear to be a serious problem for consideration for flights over Karachi; at any rate not for ordinary flights which are confined to a height of 10,000 feet. Ice-formation on the wind screen was experienced at 13 to 14 thousand feet by planes flying over Karachi in thick alto-stratus cloud on 17th December 1937. The temperature at that height was 22 to 25° F.

(ii) The temperature distribution as shown by the general run and spacing of the isotherms indicates that between 1,000 and 3,000 feet in April and May, and between 2,000 and 5,000 feet in June to September, inversions, isothermal regions and regions of low lapse rate of temperature are common, specially during June to September. The results of individual aeroplane flights also show that inversions occur during May to September, being most frequent and well marked in July and August. The closed isotherms of 74°, 76° and 78° F. indicate that inversions are very common in August. A preliminary study of the inversions over Karachi has been reported.[3] A more detailed study is being made by the authors separately.

(iii) Considering the year as a whole, there is a subsidiary maximum of temperature in October up to a height of about 3,000 feet, the main maximum being in May–June. This is due to the complete disappearance of the low clouds which are nearly always present in the day time during June–September.

(iv) The relative humidity distribution is more or less symmetrical about July which is the most humid month. The highest relative

humidity in the year occurs at a height of about 2,500 feet in July–August. This is approximately the height at which, during this period, a sheet of stratus cloud exists almost daily in the morning and evening hours near the base of an inversion marking the top of a moist layer of sea air. Above the stratus sheet or the base of inversion, there is a rapid decrease of relative humidity with height in the inversion region till the dry continental air above is reached. The closeness of the humidity isopleths between 2,000 and 5,000 feet in May to September indicates this rapid fall of relative humidity.

The lowest relative humidity in the year occurs between 4,000 and 8,000 feet in May and between 6,000 and 7,000 feet in August. In these regions, which are above the inversion, dry continental air prevails.

A detailed study of the structure of the atmosphere over Karachi taking the upper wind circulation also into consideration is in progress.

P. R. Krishna Rao.
K. L. Bhatia.
R. A. F. Meteorological Office,
Karachi Air Port,
January 28, 1939.

1 *Mem. Ind. Met. Dep.*, **20**, Part I.
2 *Ind. Met. Dept., Sci. Notes*, **7**, No. 78.
3 *Ibid.*, 50.

Constitution of Iodic Acid

That iodic acid behaves differently from its analogues chloric and bromic acids has been known for a long time. J. Thomson,[1] Ostwald,[2] Walden,[3] Rosenheim and Liebknecht,[4] Groschuff[5], Dhar[6] and others have shown that iodic acid exists in solution in the polymerised condition, some suggesting also that the iodate ion is probably divalent. In a previous paper[7] evidences were adduced to show that a 6 N. solution of the acid contains mainly $(HIO_3)_3$ molecules while a dilute solution (below 0·1 N.) only the ions of the monobasic acid HIO_3, and that the iodate ion is monovalent.

The existence of the three salts, KIO_3, $KIO_3 \cdot HIO_3$ and $KIO_3 \cdot 2HIO_3$ suggests the existence of the three corresponding acids: HIO_3, $(HIO_3)_2$ and $(HIO_3)_3$.

Since a change in constitution is taking place apparently by dilution it must be of interest to find out at what concentrations, if any, such

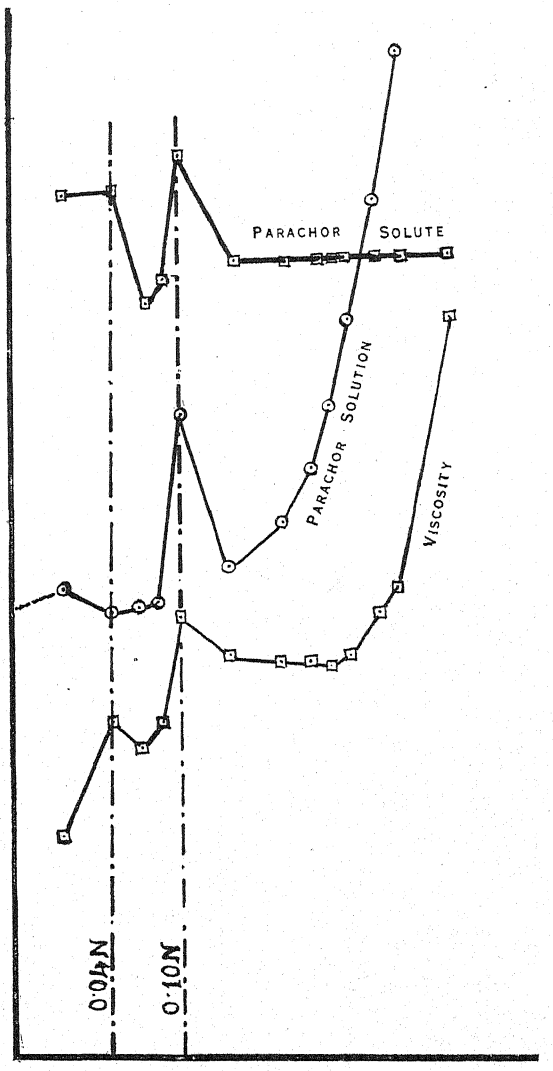


Fig. 1

changes are brought about. With this end in view a number of physical properties have been studied and graphs obtained connecting the property of the solute with the concentration. For this purpose the mixture law equation was employed:

$$P_{soln.} = (1 - x)P_{solvent} + (x)P_{solute},$$

where P denotes the property investigated, *viz.*, density, viscosity, surface tension, parachor,

refractive index, etc., and $(1-x)$ and (x) the mol. fractions of the solvent and solute respectively. When P_{solute} is plotted against concentration a remarkable similarity is observed in the behaviour of all the curves (Figs. 1 and 2), which show breaks at definite points. *viz.*,

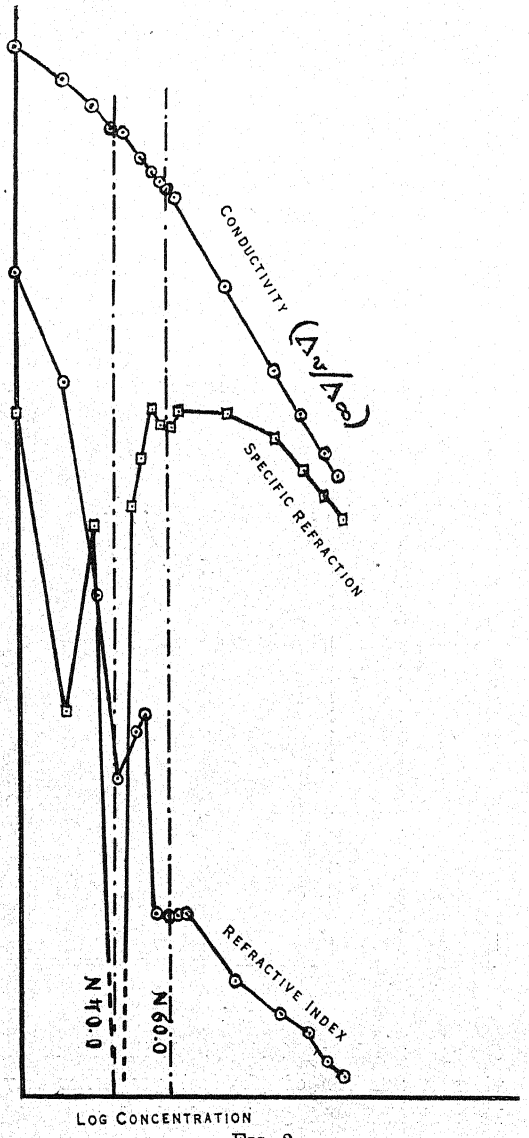


FIG. 2

0·1N. and 0·04N, indicating thereby that the phenomenon observed is a genuine one.

Evidences from Raman spectra[8] have also been obtained, which rule out the possible explanation of the formation of hydrates.

The following reactions are suggested to explain the various observations made:—

$$\underset{0\cdot10N}{\tfrac{1}{3}(HIO_3)_3} \rightleftharpoons \underset{0\cdot04N}{\tfrac{1}{2}(HIO_3)_2} \rightleftharpoons HIO_3 \underset{\uparrow}{\overset{\downarrow}{}} H^{\cdot} + IO_3'$$

The detailed paper will be published in *Zeitschrift fur anorganische und allgemeine Chemie.*

M. R. NAYAR.

Chemistry Department,
Lucknow University,
February 8, 1939.

[1] Thomson, J., *Ber.*, 1874, **7**, 112.

[2] Ostwald, W., *J. prakt. Chem.*, 1885, **32** (2), 310.

[3] Walden, P., *Z. phys. Chem.*, 1888, **2**, 64.

[4] Rosenheim and Liebknecht, *Lieb. Ann.*, 1899, **308**, 40.

[5] Groschuff, E., *Z. anorg. Chem.*, 1905, **47**, 331.

[6] Dhar and coworkers, *J. Ind. Chem. Soc.*, 1928, **5**, 585; 1929, **6**, 784; 1932, **9**, 322.

[7] Nayar, M. R., and Gairola, T. R., *Z. anorg. Chem.*, 1934, **220**, 163–68.

[8] Nayar, M. R., and Sharma, P. N., *ibid.*, pp. 169–72; Venkateswaran, C. S., *Proc. Ind. Acad. Sci.*, 1935, **2**, 119; Shen, Ya and Wu, *Phys. Rev.*, 1937, **51**, 235.

Triplo-Polyploidy in *Saccharum spontaneum* L.

AN examination of a large number of clones of *Saccharum spontaneum* collected from various parts of India, Burma, and the East Indies have shown that this species includes a polyploid series with $2n = 48$, $2n = 56$, $2n = 64$, $2n = 72$, and $2n = 80$ in India and $2n = 80$, $2n = 96$, $2n = 112$ in further India and the East Indies. One would be led to conclude from these chromosome numbers that 8 is the basic number in this species and forms with $2n = 56$, $2n = 64$ and $2n = 72$ are $7x$, $8x$ and $9x$ forms respectively. The presence of an odd set of chromosomes in the $7x$ and $9x$ forms would naturally lead one to expect univalents or multivalents at meiosis in these types. A study of the chromosome behaviour of a number of clones collected in India have shown, however, that 28, 32 and 36 bivalents are formed regularly at meiosis in these types. Consideration of the above has led me to conclude

that these forms of the species are dibasic, having arisen by hybridization of a form with ($x = 10$) and one with ($x = 6$).

Of these two types $2n = 80$, $8(x = 10)$ which is a wide-leafed form (variety *œgyptiacum* of Heckel) is found distributed in the more tropical parts of South-Eastern Asia and East Indies, while the $2n = 48$, $8(x = 6)$ which is a thin-leafed form (variety *juncifolium* of Heckel, is confined to the subtropical region of North-Western Asia and Southern Russia. The form very widely distributed in Peninsular India is one with $2n = 64$, which I have considered as a natural hybrid between the $2n = 48$ and $2n = 80$ types (Janaki Ammal, 1936).[1] Its chromosome complement can be represented as $4(x = 6) + 4(x = 10)$.

Plants with 56 and 72 chromosomes have a more restricted distribution being found in mixed populations of the $2n = 64$ chromosome type and the two primary forms (varieties *juncifolium* and *œgyptiacum*) with 48 and 80 chromosomes respectively. I have also been

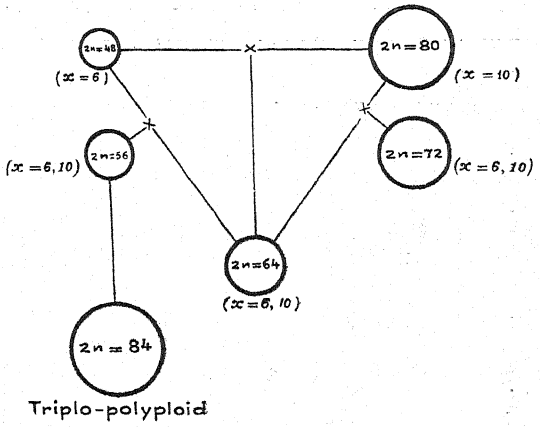


FIG. 1.
Diagrammatic representation of the types of *S. spontaneum* found in India and the relation of the "triplo-polyploid" to these forms

able to synthesize the $2n = 72$ type by crossing the wide-leafed Dacca *S. spontaneum* ($2n = 80$)

FIG. 2
A field of *S. spontaneum* showing the "triploid" giant amongst the diploids

with the local Coimbatore form ($2n = 64$) (Janaki Ammal, 1936 *b*).[2] On this basis they may be considered as true back crosses (Fig. 1). Their chromosome complexes are, therefore, as follows:

$$2n = 56 = 6(x = 6) + 2(x = 10)$$
$$2n = 72 = 2(x = 6) + 6(x = 10).$$

In studying a population of 100 selfed seedlings of a form with $2n = 56$ collected at Dehra Dun, I noticed two giant plants which stood out amongst the rest by their greater height, thickness of stem, width of leaves, size of inflorescence and increased sugar content (Figs. 2, 3 & 4). Chromosome counts in root tips of these plants showed 84 chromosomes which is thrice the haploid complement of the parent (Figs. 5 & 6). The plants are therefore "triploids", having arisen by the fertilization of an unreduced ($2n = 56$) gamete with a reduced one ($n = 28$). They are semi-sterile, but have yielded a number of seedlings on selfing. A study of meiosis in the "triploid" revealed the presence of univalents and multivalents besides a large number of bivalents. As the plant from which this "triploid" has arisen is already a complex polyploid, I have used the term "triplo-polyploid" to designate this type of derivation. In vegetative characters these "triplo-polyploid" plants stand intermediate between the *S. spontaneum* of India and the indigenous cultivated sugarcanes which they resemble. It is therefore not unlikely that

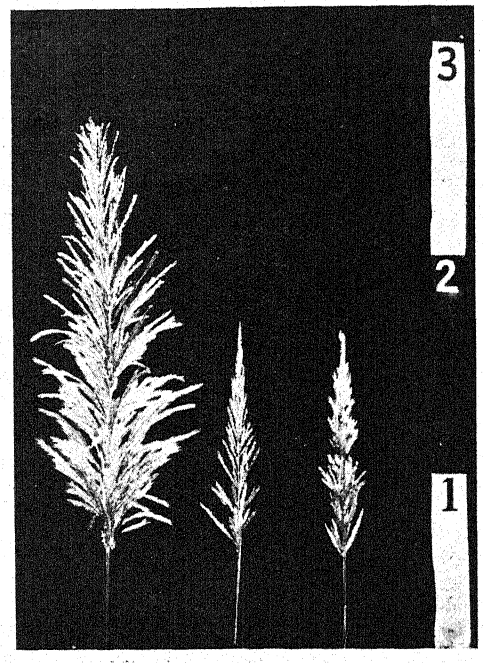


FIG. 4

Inflorescence of a "triploid" and two "diploid" *S. spontaneum* from the culture of selfed seedlings of the Dehra Dun form

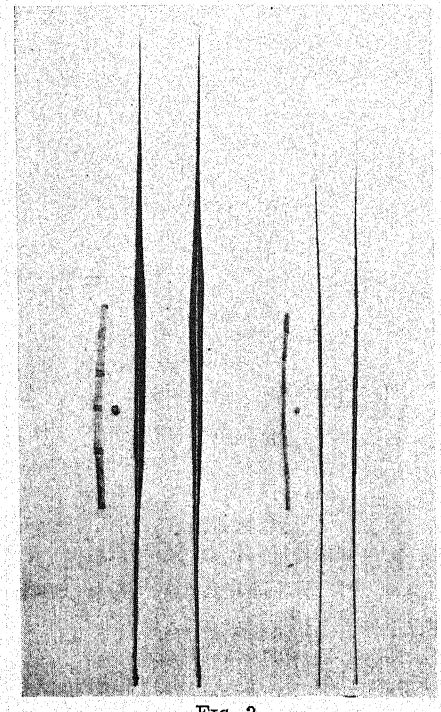


FIG. 3

Stem and leaves of "triploid" seedling of *S. spontaneum* (Dehra Dun) by the side of its "diploid" parent

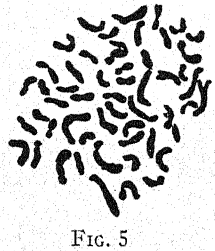


FIG. 5

Somatic metaphase in *S. spontaneum*, Dehra Dun ($2n = 56$)

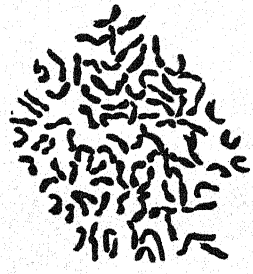


FIG. 6

Somatic metaphase in "triploid" seedling of the Dehra Dun *S. spontaneum* ($2n = 84$)

some of the sugarcanes of India have arisen from *S. spontaneum* as "triplo-polyploids". If it is so, there exists an interesting parallelism between the chromosome history of a cultivated plant like the sugarcane and the triploid mutants whose propagation as clones has likewise provided the best varieties of apples, pears, tulips and hyacinths.

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[1] Janaki Ammal, E. K., *Ind. Jour. Agri. Sci.*, 1936, **5**, 1.

[2] — *Report of the Sugarcane Geneticist*, from July 1935 to March 1936.

Separation of Lac into Sclerolac and Soft Lac Resin

PREVIOUS work[1] has shown that lac could be separated into sclerolac, the hard lac resin, and the soft lac resin. The superiority of sclero- to ordinary lac[2] which consists in its higher melting point, low water absorption value, low acid value, better adhesive strength and its capacity for thermo-hardening, has not only extended the applications of lac but to a considerable extent stabilised its position in the varnish and electrical industries. Further, this has provided the necessary impetus for the manufacture of hard lac resin on a commercial scale.

There are three methods in vogue for the preparation of sclerolac from lac: (i) direct extraction with organic solvents which extract the soft lac resin,[3] (ii) 'cold polymerisation process'[4] involving the addition of urea to an acetone solution of lac whereby, the polymerised hard lac is precipitated, and (iii) extraction of lac with dilute alkali solutions or fractional precipitation from dilute alkali solutions.[3,5]

The first two methods entail the employment of rather expensive solvents and the extractions are accompanied by heat treatment which is not very desirable in the case of a thermo-hardening material like the hard lac resin. The third method, though it does not yield pure hard lac resin, is an economical process. The small amounts of buffer salts employed for the process, will have to be thoroughly removed and the product dried before use in varnish manufacture.

We carried out experiments to find out the nature of the products yielded on precipitating lac from an alcoholic solution with water. This is analogous to the precipitation of lac from an alcoholic solution with ether, although the separation is not quite so distinct and complete. By this method, the less acidic ingredients of lac separated out as a viscous mass from the solution, the more acidic ones remaining in the supernatant. A very important factor in favour of this method is that it does not involve much extra cost when adopted by manufacturers producing machine-made shellac. Moreover, there is no likelihood

TABLE I

Treatment	Soluble fraction		Insoluble fraction	
	Acid value	Wt. in gm.	Acid value	Wt. in gm.
*25 c.c. alcoholic solution of lac + 700 c.c. ethyl ether ..	100·8	4·04	56·0	2·8
* ,, ,, ,, + 8 c.c. distilled water ..	88	3·34	71·8	3·68
* ,, ,, ,, + 10 ,, ,, ..	104·6	1·86	75·0	5·05
* ,, ,, ,, + 12 ,, ,, ..	125·7	1·09	75·8	5·68
* ,, ,, ,, + 14 ,, ,, ..	131·1	0·82	76·7	6·10
25 c.c. alcoholic solution of bleached lac *plus* 12 c.c. distilled water	107·6	1·39	77·0	3·35

* The original alcoholic solution of lac had an acid value of 81·8 and a solid content of 27·65%.

of an alteration in the chemical nature of the products as no drastic chemicals are employed in the process. Almost the same result is achieved by extracting lac with aqueous alcohol of the proper strength.

Known volumes of distilled water were added drop by drop to a measured quantity of an alcoholic solution of lac with vigorous stirring, the resulting suspensions centrifuged in each case and the acid values of the residues and supernatant were determined along with the quantities of resin distributed in the two phases. For the determination of acid value of the hard lac resin, the solution was prepared with aqueous alcohol containing the same amount of water as was present in the soft lac resin solution. The results are shown in Table I.

The hard lac resin prepared by this method can be directly used with the requisite quantity of plasticiser for the manufacture of varnishes. There is no need to get rid of the little residual moisture present since it has a very high tolerance for water.[6]

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[1] Verman, L. C., and Bhattacharya, R., *Lond. Shellac Res. Bur. Tech. Paper* No. 1, 1934.

[2] Bhattacharya, R., and Gidvani, B. S., *ibid., Tech. Paper* No. 13, 1938.

[3] Verman, L. C., and Bhattacharya, R., *ibid., Tech. Paper* No. 5, 1938.

[4] Venugopalan, M., and Sen, H. K., *J.S.C.I.*, 1938, **57**, 371.

[5] Bhattacharya, R., and Heath, G. D., *Lond. Shellac Res. Bur. Tech. Paper* No. 16, 1938.

[6] *Oil Col. Tr. J.*, 1938, **94**, 1804.

On Some Foraminifera from the Tertiary Beds near Surat and Broach (Western India) with Special Reference to the Occurrence of *Siderolites*

THE Tertiary nummulitic limestones occurring between Surat and Broach have long been known to Indian geologists, and although the earlier workers like W. T. Blanford[1] thought that a part of these Tertiary rocks were Lower Eocene in age, subsequent studies mostly based on the nature of the molluscan fauna tended to obscure this view and led to the conclusion that the lowest Tertiary beds in this locality are much younger and are equivalent to the Kirthar series (Middle to Upper Eocene) of Sind,—a view which is the one now generally accepted.

I have recently had an opportunity of examining the tertiary rocks of this area with special reference to their foraminiferal contents, the value of which in the exact age determination of lower tertiary strata is coming to be increasingly realised—thanks to the recent work of Davies, Nuttall and others. In this note, I should particularly like to refer to the foraminiferal fauna which I have noticed in a thin band of limestone confined to the western fringe of the tertiaries, and very closely associated with the Deccan trap in this area. In this limestone, we see foraminifers like *Nummulites thalicus* Davies, *N. globulus* Leym., *Operculina* cf. *canalifera* d'Arch., and also a large variety of *Discocyclina*, closely similar to, if not identical with, *D. ranikotensis* Davies, an assemblage which is clearly indicative of a Ranikot age. In addition to these, we also notice in this limestone the important form *Siderolites* (Fig. 1), the occurrence of which is evidently of great interest and significance, seeing that elsewhere this form is considered as characteristic of the Upper Cretaceous, and forms apparently similar to this seen in Ranikot beds have now been shown to belong to another genus altogether—*Miscellanea*.[2,3] The form I have noticed in the Surat–Broach area is a true *Siderolites* and is here found in association with typical Ranikot species of *Discocyclina* and *Nummulites*. Thus it would appear that the limestone containing this foraminiferal assemblage is of Ranikot age, and represents its lowermost horizon, probably equivalent to the Hangu shales.[4]

The occurrence of a Ranikot bed as part of the Tertiary sequence in this area has evidently an important bearing on the problem of the extent of the Ranikot sea in India, and shows

that this sea must have extended as far south as Surat and Broach. A detailed study of the relationship between this Ranikot bed and the

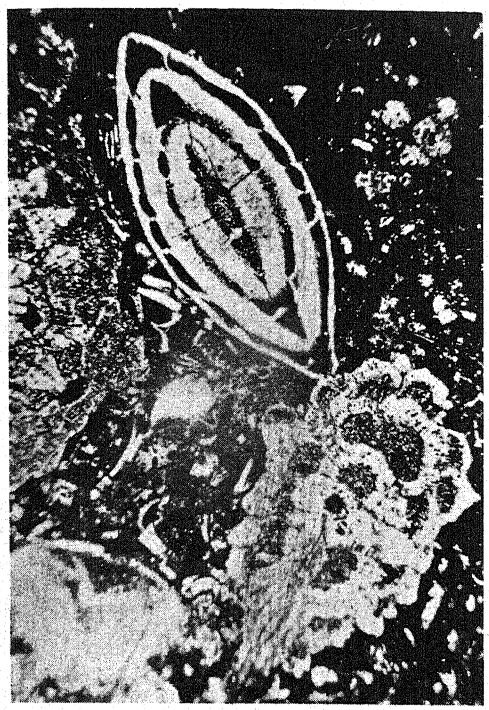

FIG. 1

Section of *Siderolites*-bearing limestone from Tarkeshwar, near Surat. × 20.

Deccan trap of the area with which it is closely associated, will also be of great value in discussing the age of these traps.

My grateful thanks are due to Lt.-Col. L. M. Davies (Edinburgh) and Prof. L. Rama Rao (Head of the Department of Geology, Mysore University) for the valuable help I am receiving in this work, and to the Director, Geological Survey of India, for loan of literature.

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Department of Geology,
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January 30, 1939.

1 Blanford, W. T., *Mem. Geo. Sur. Ind.*, 1869, **6**, 225.
2 Pfender, J., *Bull. Soc. Geo. Fr.*, 1934, **4**, 225–36.
3 Davies, L. M., and Pinfold, F. S., *Pal. Ind.*, N.S., 1937, **24**, Mem. 1, 40.
4 Davies, L. M., *Pal. Ind.*, N.S., 1930, **15**, Pt. 1, 10

The Ovule and Embryo-sac Development of Some Malpighiaceæ

SCHÜRHOFF[2] (1924) who investigated the development of the embryo-sac in some Malpighiaceæ, *Malpighia coccifera*, Linn., *M. urens*, Linn., and *Bunchosia nitida*, Jacq., has recorded sixteen-nucleate embryo-sacs developing after "Peperomia-type". A similar type of development has been recorded in *Hiptage madablota*, Gaertn., *Banisteria laurifolia*, Linn., and *Stigmatophyllum aristatum*, Linn. (Subba Rao,[4] 1937) and *Malpighia punicifolia*, Linn. (Narasimhachar,[1] 1938). Stenar[3] investigated the development of the female gametophytes in *Malpighia urens*, Linn. and *Galphimia gracilis*, Bartl., and confirmed the observations of Schürhoff on *Malpighia urens*. But he records an "Allium-type" (Scilla-type) of embryo-sac development in *Galphimia gracilis*.

The characteristic orientation and development of the ovule in *Malpighia urens* are described by Stenar as follows:—When the ovule contains a magaspore-mother cell the inner integument is very small and the outer passes on the ventral side of it up to the very top of the nucellus. Later the outer integument grows fast and forms an arch over the nucellus by the time the embryo-sac is four nucleate. The inner integument forms a ring round the nucellus which passes out of the big aperture and enlarges. A longitudinal section of the apical part of the nucellus gives the appearance of a soleshaped structure.

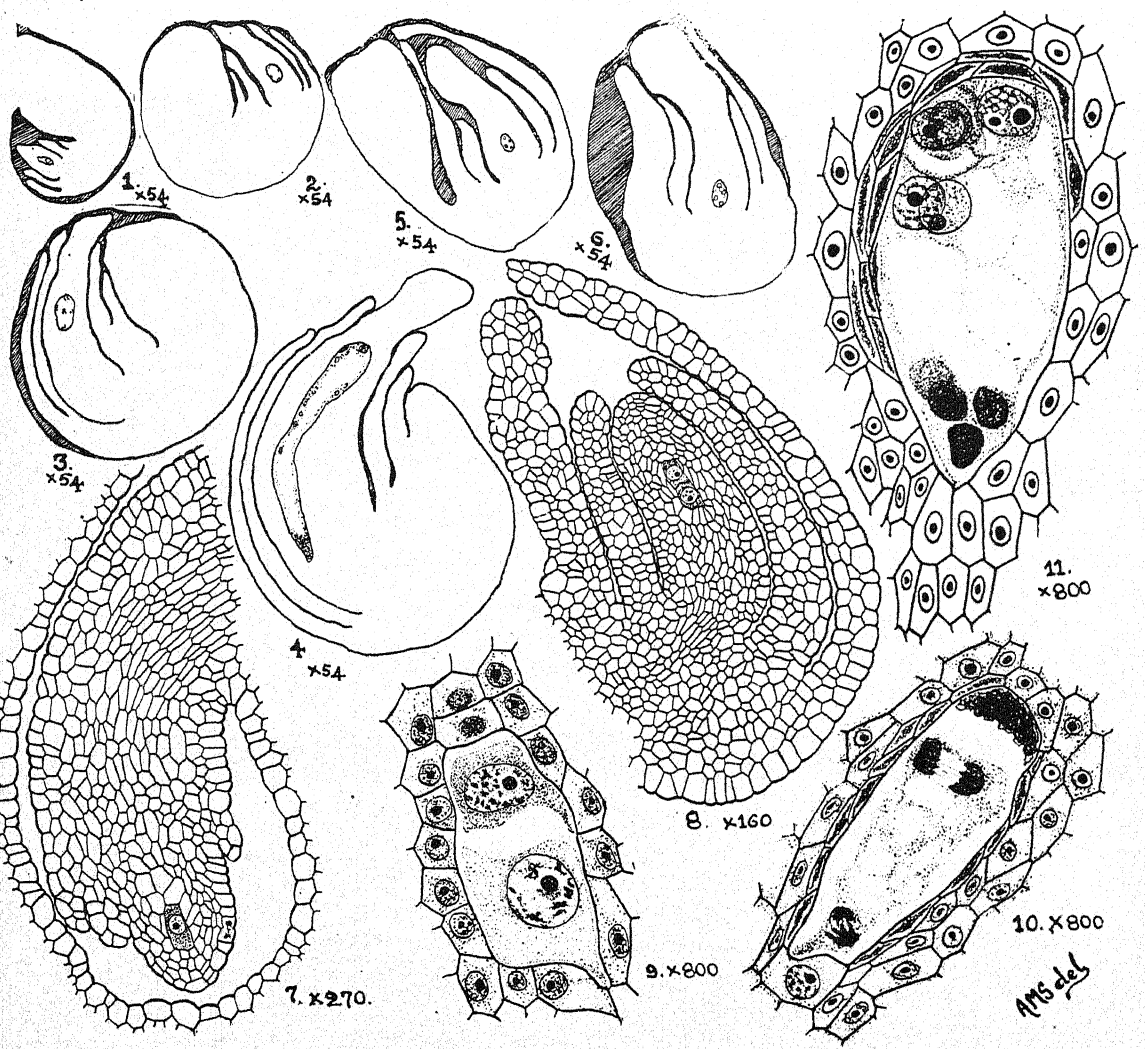
The megasporangium in the genera Hiptage, Banisteria, Stigmatophyllum and Malpighia takes its origin on a lateral outgrowth of the carpellary wall. In the very young stages it points towards the base of the ovary, but as it grows it bends near the middle of the outgrowth and points upwards. The integuments take their origin early in the history of the ovule. Their development in *Malpighia coccifera*, *Banisteria laurifolia* and *Stigmatophyllum aristatum* is similar to what has been described for *Malpighia urens* by Stenar. The big "Nucellar-beak", which is best developed in *Stigmatophyllum aristatum* (Fig. 6),—formed

by the rapid multiplication of the parietal and epidermal cells,—projects beyond the outer integument, just when the embryo-sac is four nucleate (Figs. 5 & 6), and gives a characteristic appearance. It is difficult to identify the integuments when the ovule contains a mature embryo-sac.

In *Hiptage madablota* the outer integument remains short and the inner alone grows further (Figs. 1–4). The nucellus projects beyond the inner integument and swells up. The integuments remain distinct even when the embryo-sac has a few-celled embryo (Fig. 4).

In *Malpighia glauca* Poir., the development of the integuments is more normal (Figs. 7 & 8). Even here the identity of the parietal cells is lost in older stages. As in *Galphimia gracilis* the nucellus is normal in size and it completely remains within the integuments without enlarging.

The ovules in *Malpighia coccifera* Linn. and *Tristelletia Australis*, Linn. develop as in *Malpighia urens*. The primary archesporial cell, in both, cuts off parietal cells and becomes deeply situated in the nucellus. Of the many archesporial cells only one functions as the magaspore-mother cell. The development of the embryo-sac proceeds after the "Peperomia-



type" as described for the genera Hiptage, Banisteria, Stigmatophyllum, Malpighia and Bunchosia. The mature embryo-sacs are sixteen nucleate with four groups of three nuclei with no definite organisation into the egg and synergids; and four nuclei fuse in the centre to form the secondary nucleus. The plants do not set seeds here.

The embryo-sac of *Malpighia glauca* develops after the "Allium-type" (Scilla-type) as described by Stenar for *Galphimia gracilis*. The primary archesporial cell after cutting off parietal cells functions at the megaspore-mother cell. Multiple archesporium has not been observed. The mother cell by the heterotypic division gives rise to two approximately equal cells (Fig. 8). The chalazal enlarges and the micropylar degenerates. The nucleus of the chalazal cell divides to give rise to a two-nucleate embryo-sac which ultimately develops into an eight-nucleate one (Figs. 10 & 11). Of the four nuclei in the micropylar end, three organise themselves into the egg-apparatus and the fourth fuses with a nucleus of the chalazal end and forms the secondary nucleus. The antipodals are fairly large and degenerate by the time the fusion of the polars is complete.

Further work on the development of the embryos is in progress and the details will appear elsewhere as a separate paper.

Acknowledgments are made to Dr. M. A. Sampathkumaran and Professor L. Narayana Rao for encouragement and kind guidance.

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Central College,
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January 24, 1939.

[1] Narasimhachar, S. G., *Curr. Sci.*, 1938, **6**, 507.

[2] Schürhoff, P. N., Extract from *Die Zytologie der Blütenpflanzen*, Stuttgart, 1926.

[3] Stenar, Helge, *Bot. Notiser*, 1937, 110–18. (Reprint received for reference by the kind courtesy of Dr. P. Maheshwari, University of Allahabad.)

[4] Subba Rao, A. M., *Curr. Sci.*, 1937, **6**, 280.

[5] — *Studies in the Malpighiaceæ*, 1939 (in course of publication).

[6] Maheshwari, P., *New Phyt.*, 1937, **36**, 359.

Growth of *Pythium hyphalosticton* Sideris in Synthetic Nutrient Liquid Media

ROBBINS AND KAVANAGH[1] reported that *Pythium hyphalosticton* and *Pythium aphanidermatum* (Eds.) Fitz., (*P. Butleri*) failed to grow uniformly in their medium C consisting of 5·0 gm. of $MgSo_4 \cdot 7H_2O$, 15·0 gm. of KH_2PO_4, 5·0 gm. of asparagine, 0·5 gm. of NH_4NO_3, 50·0 gm. of dextrose and 1 c.c. of mineral supplements per litre of redistilled water, either with or without the addition of vitamin B_1. This medium had a pH of 4·3. They write (p. 231), "We are uncertain whether the failure of these organisms to develop was due to unsatisfactory material used in the inoculation, to the unfavourable character of the basic medium (hydrion concentration, solute concentration), or to lack of growth substances other than vitamin B_1".

The culture of *Pythium hyphalosticton* Sideris, which is with the author, was obtained from Centraalbureau voor Schimmelcultures, Baarn (Holland). Several nutrient liquid media (10 c.c. in pyrex tubes) were tried. The asparagine was taken up in redistilled water and precipitated with alcohol. This process was repeated thrice. Stock cultures were maintained on oatmeal agar and potato dextrose agar. A bit of mycelium was used as inoculum, care being taken to avoid including any of the agar of the stock cultures with the inoculum, and each tube, after inoculation, was gently shaken the next day to allow the inoculum to sink down in the nutrient solution. The standard incubation was at 25° C. for seven days. At the end of this period cultures were examined microscopically. All experiments were performed in triplicate and all experiments were repeated. Guaranteed reagents of Merck & Co., were used. The hydrion concentrations were determined after autoclaving.

I Series:

Solution A: It contained 0.5 gm. each of K_2HPO_4, $MgCl_2 \cdot 6H_2O$, K_2SO_4, 2·0 mg. of NH_4NO_3 and 5·0 gm. of dextrose per litre of distilled water.

This solution was inoculated with *Phytophthora erythroseptica* Pethybridge,[2] *Phycomyces Blackesleeanus* Burgeff (+ strain), *Phytophthora fagopyri* Takimoto and *Mucor Ramannianus* Möller,[3] but there was no growth of these in any case, indicating that the medium was free from thiamin, pyrimidine and thiazole.

Solution B: It contained 0·1 gm. each of K_2HPO_4, $MgCl_2 \cdot 6H_2O$, K_2SO_4, 0·8 gm. of NH_4NO_3 and 1·0 gm. of dextrose per litre of distilled water.

The pH of solutions A and B was 6·8.

The author finds that *Pythium hyphalosticton* grows well in solution A and also in a dilute solution, *i.e.*, B and is transferable in them.

In view of the fact that the fungus grows in the nutrient solution free from vitamin B_1 the author thinks that it is one of those fungi, which do not require any organic growth supplement from extraneous sources but manufacture their own growth-promoting substance or substances from the elementary materials of the nutrient medium. There are indications that thiamin or its intermediates synthesized by the fungus are given off by the mycelium into the medium. These results, which require further verifications, will be published in a subsequent note.

Pythium hyphalosticton resembles *Pythium aphanidermatum*[4,5] and many other fungi in its ability to grow in a suitable synthetic liquid solution, which lacks any organic growth supplement.

II Series:

Solution C: This was medium C used by Robbins and Kavanagh. Its composition is given in the beginning of this note. Its pH was 4·3.

Solution D: This was made by diluting solution C five times (*i.e.*, 100 c.c. of solution C + 400 c.c. of redistilled water). Its pH was 4·5.

Solution E: This was prepared by diluting solution C ten times. Its pH was 4·75.

Solution F: This was prepared by adding sufficient quantity of K_2HPO_4 to solution C to make its reaction pH 5·3.

Solution G: This was prepared by diluting solution F five times. Its pH was 5·5.

Solution H: This was prepared by diluting solution F ten times. Its pH was about 5·6.

In solution C the organism did not grow at all, while in solution F it made no appreciable growth. In solutions D, E, G and H there was very good growth of the fungus, the colonies of which rose up to about 5 cm. in height in tubes and formed thick mycelial felts on the surface of the nutrient liquids, and in these it was transferable.

It has already been demonstrated that the fungus can grow in suitable synthetic solution without any organic growth supplement from an extraneous source. Therefore, its inability to grow in solutions C and F cannot be due to lack of some growth supplement, or to lack of some nutrient ingredients since it grows in them when they are diluted five or ten times. The experiments demonstrate that the concentration of solutions C and F interferes with the growth.

Robbins and Kavanagh have obtained similar results with *Pythium aphanidermatum*, which is also capable of unlimited growth when the solutions, used by them, are diluted.

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Department of Botany,
University of Allahabad,
January 26, 1939.

[1] Robbins, W. J., and Kavanagh, F., *Am. Jour. Bot.*, 1938, **25**, 231.

[2] Leonaian, L. H., and Lilly, V. G., *Phytopath.*, 1938, **28**, 533 and 540.

[3] Robbins, W. J., *Bull. Torrey. Bot. Club*, 1938, **65**, 274.

[4] — and Kavanagh, F., *Proc. Nat. Acad. Sci.*, 1938, **87**, 429.

[5] — — *Bull. Torrey. Bot. Club*, 1938, **65**, 453–61.

Insecticidal Plants

With reference to the note on "Insecticidal Plants" appearing in *Current Science*,[1] we write to say that work in this direction and more especially with Derris, *Derris ferruginea*, Pyrethrum, *Chrysanthemum Cinœrariefolium* and *Tephrosia* spp., is in progress at our Institute

since the last 18 months. The stock raised from our experimental nursery under control conditions has been distributed to different parts in the State to study the effects of varying soil and climatic factors. Details regarding their sylviculture, active principle content, etc., will be published elsewhere. We should like to record here that, contrary to the widespread impression that Pyrethrum does not flower below an altitude of 6,000 feet, the species has flowered both at Bangalore (ca. 3,100 ft.) and at Kemmangundi (ca. 5,000 ft.).

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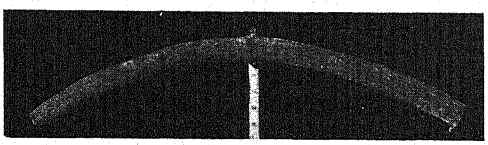
January 3, 1939.

[1] *Curr. Sci.*, 1938, **7**, 258.

A Type of Boomerang from Palanpur

OF the two types of boomerangs used in India the so-called returning type is figured both in Egerton's[1] book and in Thurston's.[2] The other type is, as far as I can know, figured only once in Egerton's[3] book. The two specimens of the first type figured by Thurston differ among themselves as well as from the specimens figured by Egerton as regards their curvature. The type occurs both in Gujarat as well as in South India as seen from the description of the specimens by Egerton[4] and Thurston.[5] Gujarat specimens are made of wood while South Indian ones are either of wood or of ivory. The other type called 'Katar' or 'Katariya' and described by Egerton as used by 'Koles' (Kolis) of Gujarat is made of wood. The one specimen of this type figured by him shows rather a sharp angle at the centre. Three such specimens are recorded by him and their length on the outer curve is given to be 2′ 6″ to 3′. He has not given measurements of width.[6] Egerton lists[7] and describes a boomerang 'Singa' from Southern India as made of steel with a length of 18″ to 21″ and a width of 2½″ to 3″. From the description, with width specified, it appears that this boomerang of steel from Southern India may be of the type of the simple boomerang of the second type and described by Egerton as being used by the 'Koles' of Gujarat. If it is so, and here I should mention that the specimen is not figured anywhere, this ordinary boomerang, like the other one, is in use both in the North as well as in the South. What the shape of the Southern type may be it is not possible to judge, for lack of illustration.

While on tour in the State of Palanpur in February 1938, I procured a specimen of the ordinary type of boomerang used by lower classes for hunting small game. The length of the curve on the outer side is 29·5″ and the width of the two ends is 1·5″ and 1·3″ respectively. As the illustration makes it clear,



the specimen has a more flowing curve than the specimen illustrated by Egerton. Perhaps the nature of the curve of this implement depended more on the natural curve of the wood used than on conscious selection.*

G. S. GHURYE.

School of Economics and Sociology,
University of Bombay,
February 14, 1939.

[1] *An Illustrated Handbook of Indian Art*, 1880, Fig. 15, 4, p. 73.

[2] *Ethnographic Notes in Southern India*, 1907, Pl. XXXVII.

[3] *Loc. cit.*, Fig. 15, 1.

[4] *Loc cit.*, pp. 78–81.

[5] *Loc. cit*, p. 56.

[6] *Loc. cit.*, p. 78.

[7] *Loc. cit.*, p. 81, No. 70.

* The specimen is deposited in the Government Museum, Madras.

INDUSTRIAL SECTION

Modern Distillery Practice as an Adjunct to the Cane Sugar Factory

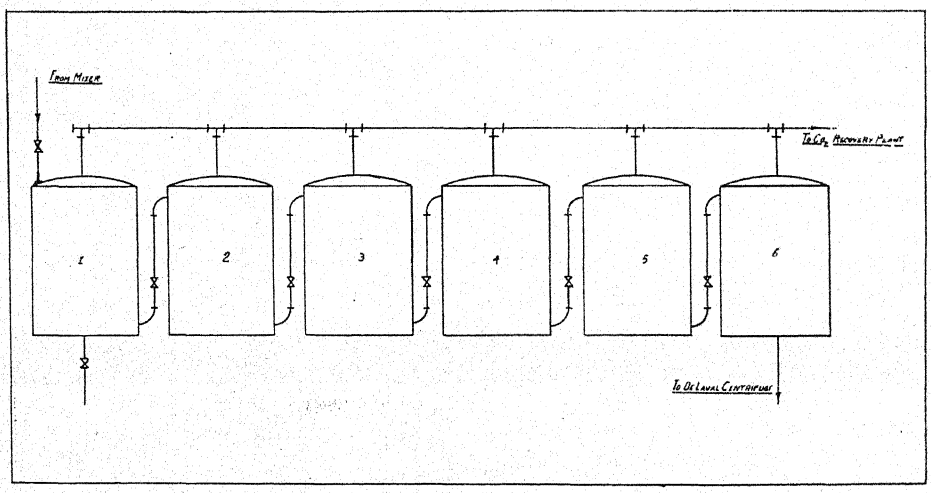
By G. Narasimha Iyengar
(Distillery, The Mysore Sugar Co., Ltd., Mandya)

WITH the development of the Indian Sugar Industry the problem of the economic disposal of molasses has ushered to the forefront the Fermentation Industry. The economic advantages accruing from the running of the distillery as an adjunct to the sugar factory may be considered. The sugar factory being a seasonal one, it is of advantage to run the distillery, the working of which is synchronous with the running of the sugar factory. Steam for distillation is taken from the sugar factory where steam is raised by the burning of bagasse and thus the steam which is one of the important items of cost in the distillery is obtained cheaply.

Louis Pasteur found that 51·110 kg. of alcohol, *i.e.*, 64·34 litres of 100° G.L. alcohol could be obtained from 100 kg. of sugar (dextrose). But practically 61·11 litres of alcohol has been the maximum yield. The difference of 3·2 litres per 100 kg. of glucose or 5·2% less than the theoretical possibility has been shown as being due to the utilisation of the sugar for the building up of the cell.

The old method consists in producing yeast—*Saccharomyces cerevisiæ*—during the fermentation of the Wort, while the multiplication of the cells goes on, and a large quantity of sugar being used for production and building up of the cells. In this new method the aim has been to minimise the losses of sugar utilised in the building up of the cells and the utilisation of this sugar in the production of alcohol.

This is realised in practice by separating from the fermented wash the adult cells (before they have lost their fermentative capacity) and "pitching" the yeast so recovered into the same volume of sugar solution so that the same concentration of cells is maintained and these adult cells convert the sugar into alcohol and carbon dioxide. It is said that the same batch of yeast could be kept for a length of 3 to 4 months and by this method from time to time a very small number of cells would die out and these are replaced by the very small number of cells reproduced during fermentation.



The apparatus consists of a number of Fermenters of equal capacity interconnected by means of pipes as shown in the figure. Initially the pure yeast culture which is acclimatised to the conditions obtaining

in large-scale fermentation is grown to about 5% of the volume of the first fermenter and then this is "pitched" into the diluted molasses solution from the dilution tanks and when this is full the cock communicating I and II is opened and the diluted molasses solution is fed into the second fermenter; when this gets filled, the cock communicating the II and III is opened and so on till the last is reached, the rate of filling being so adjusted that by the time the last fermenter is reached the fermentation is more or less complete. From this last fermenter the fermented wash before being sent for distillation is sent to a De Laval Centrifuge which is a modification of the milk centrifuge. Here the yeast is separated from the wash, the other deleterious bacteria being also carried with the latter. The amount of yeast recovered is about 10% of the volume of the wash centrifuged and this yeast is sent to a mixer where the original proportion is maintained and from this the mixture of yeast and sugar solution is run into the first fermenter. The cycle goes on continuously. The Vats are covered and the fermentation is carried on out of contact with oxygen when the multiplication of cells and the utilisation of sugar for the building up of the cells is arrested. According to Slator,[1] the rate of fermentation of dextrose by yeast is proportional to the concentration of the yeast and is independent of the concentration of sugar except in very dilute solutions. Since adult cells are used the period of incubation necessary is saved and the concentration of the cells being constant the period of primary fermentation is carried on more expeditiously. The advantages of this method over the old one may be considered:

1. The speed of fermentation is increased and time of fermentation is about half to two-thirds, the time taken by the old process, thus facilitating the use of more concentrated worts resulting in "richer" wash and consequential steam economy. Thus the capacity of the fermentation room is increased to 30 to 50% of the original thus increasing the output. Since the volume of wash handled is diminished the capital investment on a larger number of fermenters is saved.
2. Since the bacteria are separated, purity of fermentation is maintained resulting in a purer alcohol.
3. The yield of alcohol is increased from 2 to 4% as the sugar, which would otherwise have been used for the building of cells, has been reduced to a minimum.
4. Encrustation of the wash column is prevented as the yeast is separated from the wash before distillation. In the ordinary process the wash column is encrusted for a normal working of 150 days necessitating the cleaning of the column before distillation.
5. Longer life of the fermenters as the amount of acid to be used is considerably less.

The patent rights for this process has been with Usines de Mille and the cost of the equipment including royalty is more than met with by the above advantages. The centrifuge is obtainable in two sizes, (1) which permits the separation of all the yeast at 100–200 H.L. per hour and is recommended for distilleries of 150–300 H.L. capacity per day, and (2) which separates between 50–100 H.L. per hour and is recommended for distilleries of 50–100 H.L. per day. The power required for this is between 1·5–2 H.P. Now many of the distilleries on the Continent are using this process. It is of advantage as aforesaid to run the distillery side by side with the factory and increase the output per day thus reducing the cost of production. This is a very important factor especially when the alcohol is to be used for power-raising purposes in preference to other fuels, since one of the objections raised has been the "high" cost of alcohol which would enhance the price of the alcoholised motor fuel.

The working of one of the important distilleries may be cited.

Original capacity (by the old method) 500 H.L. per day.
Number of working days—100.
Increased production by the new process 1250 H.L. per 100 days.
Thus, increase in production—2.5%.
Speed of fermentation increased between 30–50%.
Encrustation of the wash column diminished.

With the Power Alcohol Scheme on the anvil of the National Planning Commission one can visualise a greater advantage of the employment of this process in distilleries working as an adjunct to the Sugar Factory in the near future, in India.

[1] Slator and Sand, *J.C.S.*, 1910, **97**, 922.

Fuel Research in the United Kingdom*

THE latest annual report of the Department of Scientific and Industrial Research, recording the progress of a number of activities of the Fuel Research Board, like the previous numbers, is divided into many sections; and experimental data are included wherever necessary in the form of tables and graphs with a view to throw sufficient light on the work under review. A few photographs and diagrams of special semi-industrial plants are also included.

At the outset, satisfaction is expressed in respect of the voluminous and extremely valuable work carried out by the field laboratories established in the major mining areas by way of undertaking "a survey and classification of the coal seams in the various mining districts by means of chemical and physical tests in the laboratory", which was one of the main lines of research of the Board. This has been achieved with the closest co-operation of the colliery owners, the users of graded fuel and other organisations. The information has been of great value not only for the marketing purposes of the coals, but also to gain an idea of the Nation's potentialities. Several difficulties in conducting the work at a central place—in the nature of proper sampling, transportation of tons of samples, etc.—have been overcome by the establishment of laboratories in the coal-fields, only the correlation and special work being carried out at the central research station.

In view of the experience gained, the previously standardised methods of analysis of coal and ash have been modified. The presence of certain elements—Barium, Titanium, Nickel, Zinc, etc.—have been detected in certain coal samples, and by submitting certain coal ashes to spectroscopic examination the presence of those elements not normally associated with coal ashes, *e.g.*, Vanadium, Chromium, Lead, Germanium, Gallium, Silver and Copper has been revealed.

Some of the University Laboratories have been engaged in special investigations on the oxidation of carbon and the constitution of coal, subjects of considerable technical importance and also of intrinsic scientific interest, and views on the results achieved so far have been recorded.

Owing to the considerable attention paid to the sized grades of coal put on the market, work carried out by the Board has included investigations on the types of 'picks' used in breaking, the avoidance of unwanted breakage and the undue formation of fines, and the wet and dry methods of cleaning coal. They have been able to overcome the dust nuisance commonly attached to the coal conveyers, screening plants, etc., by sprinkling certain fluids in very small proportions on the broken coal. This method of dust-proofing coal has the additional advantage of protecting coal from weathering. A study of the physical structure of coal, employing *inter alia* the X-ray methods, has been of considerable interest in the determination of the absorption properties of certain fluids by different types of coals.

In regard to the work on carbonisation and gasification of coals, attention has been specially directed to the utilisation of low grade coals for metallurgical purposes by studying the characteristics of special blends, and the production of gases of special composition required for the development of synthetic processes for the production of oils and fatty acids. The investigations were carried out on the different types of large-scale retorts and the necessary working conditions have been ascertained for the success of the processes. Interesting results have been recorded with the modified operation of water gas plants fitted with a chamber for the catalytic reduction of carbon monoxide to methane, on the lines suggested by Sebastian. The results have been encouraging and water gas of high calorific value may some day be expected to be supplied to consumers instead of the more expensive coal gas.

Coal tars and oils have been subjected to hydrogenation in order to obtain motor spirit. In this connection, observations on the treatment of low temperature and high temperature tars have been recorded and it is suggested that the latter are not amenable to the treatment to the same extent as the former. Results of a mild hydrogenation treatment of crude benzole have been recorded to show how the process can be successfully worked for desulphurization of the hydrocarbon.

As a result of the cracking of higher boiling 'hydrogenated oils' unsaturated hydrocarbons are obtained which, when polymerised, give oils with lubricating properties. The results of this investigation have been encouraging to such an extent that a semi-technical scale plant has been designed and operated to synthesise olefines from mixtures of carbon monoxide and hydrogen, after the Fischer-Tropsch reaction. The large quantities of synthesised olefines—particularly ethylene—are next subjected to polymerisation in the presence of catalysts. This work has yielded a variety of products, such as lubricating oils, waxes for soaps, and acids for the production of esters.

Besides the continued progress of the process of hydrogenation of coal, steps have been taken to use pulverized coal in internal combustion engines where partial success has already been attained. Designing of long-wearing engine cylinder parts is one of the important items in this investigation.

The Board has been taking keen interest in the design of open fire grates for burning blended cokes, a problem of wide interest.

The report is a record of the multifarious activities in which the Board is engaged. The necessity for establishing such an institution in India has been stressed from time to time by all those having some kind of interest in the country's fuel problems. At present, investigations even of a preliminary nature are in progress in a few laboratories only, and there are evidently numerous difficulties in undertaking extensive research schemes whereby the coal

* *Report of the Fuel Research Board* (His Majesty's Stationery Office, London), 1938. Pp. x + 255. Price 4*s.* nett.

resources could be properly surveyed and classified; but then alone can a proper control be obtained on the economic utilisation of fuels in general. The Geological Survey of India have issued a number of bulletins from time to time embodying the preliminary work of an analytical character regarding some coalfields. The fuel laboratories of the Universities of Bombay and Calcutta and the Indian School of Mines have been adding to the meagre information on most of the coal deposits from time to time; but the work will have to be much wider in scope to enable the mining proprietors and coal users to profit by it. The outstanding results achieved by the Fuel Research Board in England, which have been partly recorded in the report, should be enough to stress the importance of an organisation of that kind to this country.

M. R. MANDLEKAR.

Modern Tendencies in Mathematics*

DURING the last hundred and fifty years, not only an immense advance has been made in the direction already indicated by the old masters like Descartes, Newton, Leibnitz, Euler and Lagrange but entirely new branches of mathematics were created such as Projective Geometry, Functions of Complex Variables and the whole vast subject of mathematical physics. Sometimes, the development in mathematics went hand in hand with the progress of the natural sciences, and new methods of attack were developed in order to solve the problems set by these sciences. At other times the trend of events has been in the opposite direction. Many subjects in mathematics were developed purely for their own sake, and it was only at a later date that most of these abstruse ideas found applications in practical problems. Complex Variables, Differential and Integral Equations, Tensors, Quaternions, Matrices and Groups have become powerful tools in the hands of the physicist. Having conquered the domain of the natural sciences, mathematics continues in its triumphal march into the realm of the biological and sociological sciences as well. It is thus becoming more and more indispensable for all knowledge and the conviction is gaining ground that the formulation of all the fundamental laws of nature requires its use.

Another characteristic development of modern times is the rise of the deductive method. In mechanics, for example, it has become customary to start with Hamilton's variational principle and deduce Newton's Laws. This tendency has resulted in the unification of various theories and various branches of knowledge.

Dr. Siddiqi pointed out that the progress of mathematical sciences up to the nineteenth century was mainly in the constructive direction, that is, in the direction in which we start from familiar conceptions and then advance in a synthetic way towards gradually increasing complexity. But with Gauss, the critical discipline was also introduced. Gauss and Cauchy were the first mathematicians to realise the insecure foundations on which mathematics was built, and they turned their attention to a critical examination and rigorous formulation of the whole subject. This work was carried on by Abel, Riemann, Weirstrass, Dedikind and Cantor. This process led to the great and important movement called "the Arithmetisation of Mathematics", started by Kronecker and Weirstrass. The greatest achievement of the late nineteenth century was Cantor's theory of sets, and his first mastery over the world of infinity. It has had a far-reaching influence both on pure mathematics and its applications. The theory of sets contributed a great deal towards clearing the foundations of mathematics, but the theory itself was not founded on a secure basis, as it led to many paradoxes. Investigations connected with these difficulties have thrown much light on many of the most fundamental problems of human knowledge. The solution has been attempted in three different ways by different schools. The difference is not only methodical; it consists mainly in the whole mathematical outlook.

The Intuitionistic School, led by Bronwer and Weyl, considers pure existence theorems as illegitimate. For this school existence in mathematics means constructability. It also rejects the age-old "Principle of Excluded Middle", *i.e.*, the principle that out of two opposites one must hold. It applies this to the Decision-problem, and says that contrary to the general belief, every mathematical problem is not necessarily soluble.

The Logistic School of Bertrand Russell forbids the use of non-predicative definitions. It has revived the old idea that mathematics is a part of logic. This conception of logicism has had a sequel in the modern tendency to do away with the ordinary language, with its uncertainties and confusion, and to use a purely symbolical language.

The Axiomatic or Formalistic School has been founded and developed by David Hilbert. The axiomatic method, as distinguished from the genetic method, tries to build up a subject on a system of suitably chosen axioms. The fundamental problems then are those of proving the independence, completeness and self-consistency of the axioms.

The controversy between these different schools of thought is still raging, and it is not yet possible to forecast the direction to which mathematics of the future will tend.

* From an Extension Lecture delivered by Prof. R. Siddiqi on 10th January 1939, under the auspices of the Aligarh Muslim University.

Vitamin A Deficiency and Night Blindness

THE relationship between night blindness, or dark adaptation, and vitamin A deficiency remains inconclusive despite tests with various optical instruments to determine the status of vitamin A nutrition from the values of threshold measurements, according to a note recently issued by Messrs. Bausch & Lomb, Rochester, New York.

The phenomenon known as dark adaptation, the ability to see in relative darkness after exposure to light, has been studied extensively. Fundamentally the process is a photochemical reaction in which visual purple, the light-sensitive pigment in the rods of the retina, is desensitized to dim light by exposure to bright light and resensitized to dim light through regeneration in darkness.

Photometric tests conducted by Palmer and Blumberg in a routine survey of 585 school children showed a great variation in successive tests of the same individuals. These findings were interpreted as indicating that very little dependence could be placed on results based on single tests of children and that methods for classifying photometric measurements to represent different degrees of vitamin A deficiency were inadequate.

This opinion has been confirmed by the recent study of Dr. Carroll E. Palmer, in a paper presented before the Child Hygiene Section of the American Public Health Association.

Selecting a group of school children whose dark adaptation tests indicated vitamin A deficiency, borderline subnormal, and a few normal, Dr. Palmer separated them into two groups, one for a series of feedings and the other as a control. Preliminary to the feeding study, each child received three light threshold tests to obtain data on the reliability of the readings. Following this each child was given a test every week for five weeks, during which each child in the feeding group received an average of 18,000 International Units of vitamin A daily, or a total of 630,000 I.U. in five weeks, in the form of halibut liver oil capsules. The control group received daily supplements of 0·05 International Units of the vitamin in similar capsules.

A series of visual threshold readings were made following a standardized exposure of the subject's eyes to bright light. Readings were made at 25 seconds and at 10 minutes, following exposure to bright light. Adaptation occurs in two parts, the first begins at once; it is rapid and attributed to cone function. The second part occurs later and is due to rod function. The intensity range covered by the rods and cones during dark adaptation depends upon the colour of the light, its area and retinal location, and the intensity of the preceding light adaptation.

Palmer's analysis showed marked improvement in the averages of the threshold measurements in successive tests on both groups of children. In the first preliminary test both the feeding and the control group indicated vitamin A deficiency. The average for the group that was subsequently given large doses of vitamin A was a little lower than that for the control group.

On the fourth preliminary test, however, the averages for the two groups were identical. During the five weeks of supplementary feeding, the averages for both groups continued to increase. At the end of the experiment approximately 45 per cent. of both groups gave readings below what is considered normal. The two groups were essentially alike at the end of the feeding period.

"As a result of these findings, particularly in view of the enormous variability of the measurements," reports Dr. Palmer, "it is not possible to attribute the improvement in the measurements conclusively to the supplementary vitamin feeding."

The shortcomings of the photometric technic, with any instrument at present available, indicate that no interpretation of vitamin A deficiency by this means is dependable.

Dr. Palmer reports that "The possibility exists that few or no children with vitamin A deficiency were actually included in his study". "These latter impressions," says he, "are further supported by the findings of the present investigation that a large proportion (45%) of the children who originally had subnormal or borderline readings failed to give normal adaptation measurements at 25 seconds even after receiving vitamin A concentrates.

"If such a large proportion of apparently healthy children fail to give normal measurements after supplementary feeding, it seems indicated that the proposed photometric standards for dark adaptation measurements may be incorrect or too rigorous."

Dr. Palmer concludes that the photometric technic in its present form cannot be considered a reliable or satisfactory method for detecting mild forms of vitamin A deficiency in children. "Careful evaluation of all the evidence now available reveals that conclusive results, either favourable or unfavourable, have not yet been obtained".

In addition to the inadequacy of present instruments and methods, night blindness, or slow adaptation, may be a corollary to various pathologic conditions which create variations in the readings.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Bartram, William (1739–1823)

WILLIAM BARTRAM, an American naturalist, was born February 9, 1739 in the house of stone erected by his father John with his own hands in his Botanic Garden (the first in the new world) in Philadelphia. William early displayed great talent for drawing natural objects. Various trades were attempted; for example, Benjamin Franklin offered to teach him printing. In 1765–66, he accompanied his father in exploring all the 400 miles of St. John's River. In 1773–77, William explored the south-eastern part of the U.S.A. In 1782 he was elected Professor of Botany in the University of Pennsylvania but declined the position for reasons of health.

His Fame

The chief cause of Bartram's fame is his fascinating *Travels through North and South Carolina, East and West Florida, the Charokee Country, the Extensive Territories of the Muscgulges or Creek Confederacy and the County of the Chactaus.* It was republished and translated in England, Ireland, Germany, Holland and France. The literary influence of the *Travels* was immense. "It is a work of high merit every way" wrote Coleridge, whose *Kubla Khan* is as much based on it as Wordsworth's *Ruth.* The *Travels* reveal a man with a deep reverence for the Creative Spirit he felt in all about him. For him the solitary "Woodpelican", alone on the topmost limb of a dead cypress, "looks extremely grave, sorrowful and melancholy, as if in deepest thought" and we find Wordsworth echoing the same in the *Prelude*

....and the pelican
Upon the Cypress spire in lonely thought
Might sit and sun himself—Alas! Alas!
In vain for such solemnity I looked.

His Honours

Bartram's varied knowledge was at the service of all who applied to him; he corresponded with naturalists abroad and was a member of many foreign societies. In his own country he became (1786) a member of the American Philosophical Society, which was founded by his father and Benjamin Franklin. His thought, his findings and his drawings were freely incorporated in the contemporary books. Alexander Wilson's *American ornithology* (1808–14) owed its inspiration to Bartram.

His End

Bartram lived as a bachelor in his father's Botanic Garden all through his later life. He had just finished writing the description of a plant and was stepping out for a stroll in his beloved Garden, when a blood vessel in the lungs ruptured and he died suddenly, July 22, 1823.

Gibbs, Josiah Willard (1839–1903)

JOSIAH WILLARD GIBBS, an American mathematician, was born in New Haven, February 11, 1839. Both his parents were graduates. He took prize in Mathematics and Latin in Yale College and graduated in 1858. He took a doctorate in 1863 and after teaching Latin and Natural Philosophy for some time he spent three years in Europe and came under the influence of several of the most distinguished mathematicians and physicists of the world. In 1869, he returned to New Haven and in 1871 he was appointed Professor of Mathematical Physics in his own college and he continued as such for thirty-two years until his death.

His Influence

As the classics were the fashion in those days, he attracted few advanced students. He is said to have remarked a year before his death that during thirty years of his professorship he had had only about half a dozen students really equipped to profit by his lectures. Gibbs' influence came chiefly from his writings.

His Contributions

Multiple algebra, vector analysis, thermodynamics, theory of light and theory of electricity were the fields of knowledge enriched by the twenty-one papers and the two books of Gibbs. Most of the papers were published in the *American journal of science.* Of the books, *Vector analysis* was first privately printed (1881–84) for the use of his class and published in 1901 in a greatly expanded form by one of his students. It was the result of his gift for elegance and conciseness and his earnest effort to devise a calculus by which the more or less complicated space relations of physics could be conveniently and perspicuously expressed. He also called attention to the great saving of labour, which the use of this calculus would cause in certain astronomical problems such as the determination of orbits and the solution of differential equations giving the perturbations.

Statistical Mechanics

His last work *Elementary principles in statistical mechanics* (1902) may be said to have supplied one of the great deficiencies in the scientific record of the nineteenth century. In spite of many dogmatic assertions that heat was a mode of molecular motion, this principle had not been put on a firm foundation until Gibbs established that the extra-dynamical laws of heat were consequences of the immense number of independent mechanical systems in any body—a number so great that only certain averages are perceptible. In the first twelve chapters, Gibbs forges out a perfect weapon for attacking the problem and its triumphant use in the last three chapters, makes

the familiar formulæ of thermodynamics appear almost spontaneously.

His collected papers were published in two volumes in 1906 and two volumes of *Commentary* on these papers were published in 1936 to honour his memory.

Gibbs died at New Haven, April 28, 1903.

Seeley, Harry Govier (1839–1909)

HARRY GOVIER SEELEY, an English palæontologist, was born in London, February 18, 1839. In the early years he found a copy of Lyell's *Principles of geology* in the London Library and this stimulated interest in natural history. Under the old regulations, it was possible for him to gain admission to the British Museum Library even at seventeen. This opportunity he used to the fullest during the next three years. He supplemented his study by attending the lectures of eminent professors like Owen, Forbes and Brayley. He also received encouragement from Woodward of the Geological Department of the British Museum.

When he went to Cambridge in 1859 for literary work, Professor Sedgwick invited him to be his assistant. The regard that the Professor had for the young Seeley is shown by a letter of his, which reads: "In youth, you had a reputation for genius.....It was that reputation which made me seek you out and secure your co-operation as my assistant and fellow-labourer". Till 1871, Seeley stayed in Cambridge and did considerable research work. From 1872, he held various teaching posts in London.

His Publications

In addition to eight books published between 1870 and 1901, Seeley contributed nearly 200 papers to the organs of learned societies. His ten years' work in the Woodwardian Museum of Cambridge resulted in the publication of the much valued *Index to the fossil remains of Aves, ornithosauria and reptilia* (1869). The most voluminous sequence of his papers entitled *Researches on the structure, organisation and classification of the fossil reptilia* appeared regularly in the *Philosophical transactions* from 1888 to 1896.

Field Teaching

Besides the valuable addition he made to palæontological knowledge as disclosed by his papers, Seeley did much to popularise scientific knowledge and scientific method. From 1880 to 1890 he gave lectures for the London Society for the Extension of University Teaching and established the London Geological Field Class, in which he conducted excursions week by week for twenty-one years in the summer. And now it has borne fruit in the recognition by the University of London, of Field Teaching as a necessary condition for graduation in Geology.

Seeley died in London, January 8, 1909.

Verrill, Addison Emery (1839–1926)

ADDISON EMERY VERRIL, an American Marine Zoologist, was born at Greenwood, February 9, 1839. He received his early education at Norway Liberal Institute. Even before his thirteenth year, he had learned to recognise the varieties of rocks and minerals in his native place and had built up a herbarium of several hundred species of wild flowers. At seventeen, he had acquired a collection of the local shells, insects, amphibia, reptiles and mammals and identified them.

In 1859, he entered the Harvard College and came to work under the great Agassiz. Instead of listening to lectures and studying, he was asked by Agassiz what field appealed to him. On replying he was most interested in birds, he was asked to make a study of the goose. After some weeks, when the young Verrill had completed what seemed to him an exhaustive study of the bird's anatomy, Agassiz genially pointed out to him the incompleteness of his investigation and gave him directions for several months' additional work. A new subject was then taken up.

His Career

Verrill was called to Yale University as its Professor of Zoology in 1864, and he held that post till 1907. From 1871 to 1887 he was also in charge of the scientific work of the United States Commission of Fish and Fisheries. In connection with this, he devised a cradle sieve, a rake dredge and a rope tangle for collecting star fishes in oyster beds.

Dictionary Work

For several years prior to 1890, he worked on Webster's *International Dictionary* and furnished all the zoological definitions and illustrations.

His Publications

Verrill was a profuse writer for about 64 years. His contributions number nearly 300. While they cover a wide range, the majority deal with marine invertebrates—particularly those of the Northern New England Coast, the Gulf Stream, the Pacific Coast of Central America, the Bermudas and the West Indies. He estimated that he had discovered a thousand undescribed forms. At eighty-five, still sturdy and vigorous, he extended his exploration to the Hawaiian Islands and discovered many new species. His most exhaustive work is said to be that on corals and cœlenterates, including his studies of the collections of the Canadian Arctic Expedition. Some time before his death, he had placed in the hands of the publishers his monograph on the Alcyoneria consisting of upwards of a thousand pages of manuscripts and 150 plates.

Verrill died at his son's residence in California, December 19, 1926.

ASTRONOMICAL NOTES

Planets during March 1939.—Venus will continue to be visible in the eastern sky for about a couple of hours before sunrise; it is gradually moving towards the Sun and getting fainter. Mercury will be an evening star during the month, and on March 17, reaches greatest elongation (18° 27′ E). Mars is in quadrature with the Sun on March 21 and will be on the meridian at about the time of sunrise; it is becoming brighter, the stellar magnitude being 0·7 about the middle of the month.

Jupiter is in conjunction with the Sun in March 6 and will not be in a favourable position for observation during the month. Saturn continues to be an evening star and will be moving slowly eastward along the southern border of Pisces. Uranus is in the neighbouring constellation Aries, only a degree north of the fifth magnitude star σ Arietis; on March 24, the Moon will closely approach the planet. Neptune is in opposition to the Sun on March 13 and its stellar magnitude at the time will be 7·7. The planet will be situated approximately midway between the stars β Virginis and σ Leonis and can be located with a small telescope.

Comets.—Information has been received of the discovery of a comet (1939 *a*) by Cosik at Tashkent on January 17 and independently three days later by Peltier in America (U.A.I. Circular 736, 737). The comet is stated to be a diffuse object with a central condensation and a tail somewhat less than a degree. It was of the eighth magnitude at the time of discovery and has subsequently become brighter. An observation on February 10 shows that the comet was not far from Saturn. A parabolic orbit has been computed by Cunningham and the time of perihelion passage is found to be 1939 February 6. From the ephemeris based on this orbit, the comet appears to be moving rapidly in a south-easterly direction.

A Supernova.—Zwicky has reported (U.A.I. Circular 737) the discovery of a supernova in the extragalactic nebula N.G.C. 4636, about 0·6 north-west of the nucleus. The apparent brightness increased from magnitude 14 on January 17 to 12·5 on January 20. These objects are considered to belong to a distinctly separate class of temporary stars whose luminosity at maximum is about a thousand times greater than that of ordinary novæ.

T. P. B.

SCIENCE NOTES AND NEWS

The Nichrome-Constantan Thermocouple.—In a communication, dated January 16, 1939, Messrs. M. R. Mandlekar and P. K. Sathe (Fuel Laboratory, Department of Chemical Technology, University of Bombay) write:—

In connection with the investigations in progress in this laboratory pertaining to industrial classification of Indian Coals, different base metal thermocouples[1] have been used for recording temperatures. The previously covered temperature range (upto 800° C.) has now been required to be extended to 1000° C. Nichrome-Constantan couple which was previously found to be highly satisfactory has been used at the higher temperatures with similar results. It has been observed that the temperature-e.m.f. relationship of the thermocouple, followed over the preliminary temperature range, can be extended to the higher range as well. A straight line relationship is followed over the temperature range covered in this investigation, a characteristic to be valued much in a thermocouple. This relation is followed at temperatures over 300° C. and an algebraic relation between the e.m.f. (*e*, in millivolts) and temperatures (*t*, in ° C.) has been established for temperatures 300–1000° C. for the Nichrome-Constantan thermocouple.

$$t = 14{\cdot}705\, e + 47{\cdot}1.$$

[1] Mandlekar and Banerjea, *J. Soc. Chem. Ind.*, 1938, **57T**, 276; *Curr. Sci.*, 1938, **6**, 447.

The Electron Microscope.—When the aperture of a lens is continuously diminished so as to minimise the spherical aberration and thus produce a well-defined image, diffraction effects due to the finite wave-length of light set in and the resolving power suffers in consequence. For this reason complicated lens combinations and ultra-violet light are employed to increase the power of a microscope and yet objects smaller than 0·15μ cannot be separately distinguished. Now it is known that electrons can be brought to a focus by axially symmetric fields while their de Broglie wave-length being very small, diffraction effects are not produced even when the aperture is drastically cut down. A very thin section of an object mounted on an extremely thin film of nitro-cellulose or sometimes collodion is placed in vacuum in the path of a pencil of electrons which have passed throuh a very small aperture, and they then pass through ironclad coils which behave like the condenser, objective and projection eyepiece of a microscope. They then fall on a fluorescent screen or photographic plate and "silhouette" images having a high degree of magnification (upto 16000) and a resolving limit at present of about 0·01μ are produced. The pioneer workers in this field have been Knoll, E. Ruska and H. Ruska on the continent. In England similar work has been taken up by Prof. L. C. Martin, who has contributed an article on this subject to *Nature* (1938, 142, 1062) from which the present account has been prepared. A picture of the

apparatus designed by Prof. Martin and reproductions of interesting photographs obtained by Ruska are given in Prof. Martin's article. He there discusses the various difficulties which beset the path of progress in this field. The most important of these difficulties are the production of homogeneous pencils of electrons all having the same velocity (so that 'chromatic aberration' can be got rid of) and the building of ironclad coils, which, besides mechanical symmetry, possess magnetic symmetry to that high degree which is necessary to eliminate the 'spherical aberration' in such 'lenses'. When it is remembered that at present the high magnification to be brought about in two stages requires the whole instrument to be given a length of about two metres, and that the most stringent demands of high vacuum and symmetry have to be met, no one can fail to realise the difficult nature of the work. The effect of the electrons and nuclei of the object illuminated must also be taken into account, while there is also the possibility that the object may be disintegrated by the intense electron beam employed. While the X-ray and Electron-diffraction techniques are most useful in elucidating the regularities of crystalline and other kind of structure, electron microscopy will come in most handy in giving us a knowledge of the discontinuities and irregularities occurring in the same. The future is very bright as regards further improvements in this field and we may hope for the day when even the elements of crystal lattices may be made visible.

T. S. S.

* * *

Gold in some Fungi.—Nemec and Babicka (*Chronica Botanica*, 1938, 4, 12) report having succeeded in proving the presence of gold, in traces, in the cells of plants growing on auriferous soils. More recently they have been able to demonstrate its presence in fungi also. Thus the spores of the genus *Polyporus* and their host plants (Beeches, Heinbuche) contain gold in traces.

Two species of *Boletus* (*B. bulbosus* and *B. rufus*) collected in 1935 and 1937 in Westslovakia were analysed. The following results were obtained: *B. bulbosus* (1935): Ash, 6·51; SiO_2, 1·28; CuO, 0·10; $Fe_2O_3 + Al_2O_3$, 6·01; CaO, 58·01; MgO, 6·20; Na_2O, 5·50; K_2O, 4·35; P_2O_5, 15·56; CO_2, 1·50; SO_3, 1·00; Cl, 0·5; Au, 0·0001. (Figures represent percentages of the ash.) The material collected in 1937 showed only a slight variation; but gave rather surprisingly, 0·53 per cent. of ZnO in the ash.

B. rufus also showed the presence of gold. This species was analysed for confirmation of the above analytical results. *Dœdalea gibbosa*, parasitic on the stems of beech trees, contained also traces of gold.

It would be highly interesting to ascertain whether such absorption of gold is found in plants growing in the Kolar Goldfields area and how far such results could be used in locating auriferous regions.

* * *

Significance of Trace Elements in Metals and Alloys.—Non-ferrous metallurgists have devoted considerable attention to the influence of 'trace elements', the term being applied to designate elements present in amounts less than 0·05 per cent. According to the *Instrument Bulletin* (Bausch & Lomb, Rochester, N.Y., Dec. 6, 1938), the lead of commerce contains a number of trace elements—silver, copper, arsenic, antimony, tin, zinc, iron and bismuth, in amounts less than 0·01 per cent. Pure lead (99·999 per cent.) exhibits such low tensile and creep strengths that it is of little commercial interest. Knowledge regarding the effect of trace elements in zinc-base alloys containing about 4 per cent. aluminium has led to significant developments in the die casting industry. An alloy containing only zinc and aluminium (96 of Zn and 4 of Al) has very valuable properties, but if contaminated with traces of lead (0·01 per cent.) and tin (0·005) the castings will not retain their desirable physical properties when exposed to warm, humid atmospheres. Magnesium (0·02 – 0·04 per cent.) is decidedly beneficial and tends to counteract the effects of tin and lead.

* * *

Rajgir in Ancient Literature.—Pursuant to its policy of publishing Monographs on India's ancient capitals, the Archæological Survey of India have just brought out, in its series of Memoirs, a Monograph on 'Rajagriha in Ancient Literature', based upon a critical study of various ancient texts. The author is Dr. B. C. Law.

One of the most wonderful cities of ancient India, which goes back to the days of the Buddha and continues to be a place of pilgrimage and a health resort even to the present day, the identification of Rajagriha, still known as Rajgir, is rendered easy by the configuration of the hills by which it is surrounded, the other name of the town being Girivraja, or mountain fastness. The *Mahabharata* mentions Rajagriha as the capital of king Jarasandha, and as the place was hallowed by the presence of the Great Master, it is frequently mentioned in Buddhist literature. Modern excavations have been particularly fruitful at Rajgir and there is, it is said, ample scope for research at this most ancient historical city.

Details are given in the publication of the various names by which the ancient city of Rajagriha was known and their significance as also of the topography of the various sites in and around the city and of the hot springs, the bamboo forest, the mango grove of Jivaka, the Sattapanni cave and other places associated with incidents in the life of the Buddha and the history of Buddhism. The importance of Rajagriha in the religious and cultural history of India is brought out and in particular it is shown how, from the earliest times, Rajagriha was a notable centre of Naga worship—a conclusion confirmed by the recent discoveries of the Archæological Department.

The identification of the five hills that enclose the city has always been a matter of some difficulty and confusion owing to the contradictory writings in different periods. A satisfactory solution is now given of the problem in the Monograph.

* * *

Official List of Trade Names of Indian Timbers.—The Forest Research Institute and

College, Dehra Dun, has just brought out a new list of trade names of Indian timbers.

The first official list of trade names for Indian timbers was published in March 1929, and reprinted with a few additions and alterations in 1931.

Since then, experience has shown that the list was by no means perfect. It contained several names which were definitely unsuitable, and in addition several species were included in the list for which trade names were really unnecessary.

The Board of Forestry, which met at Dehra Dun in October 1934, decided, therefore, to publish a revised list of official trade names for Indian woods. The list prepared accordingly had the approval of the Board of Forestry, at which the Head of the Department of Forestry from each Province in India was represented.

The new list of trade names now brought out, is fundamentally the same as that published in 1934. A few necessary alterations and additions have been made, and several common vernacular names added. All Provinces were consulted, and every endeavour has been made to give effect to the suggestions received. In a few cases, where the suggestions of one Province clashed with those of another, the decision of the Inspector-General of Forests has been taken.

The separation of Burma also complicated matters, but it was finally decided to leave in all Burma timbers originally included if they also occurred in India. Other Burma timbers not found in India but imported into India, have been tabulated in a separate list, but included in the present publication.

The list now brought out carries the approval of every Province in India and is published under the authority of the Government of India. It is hoped that Forest Officers and others will do their utmost to further the use of these trade names, with a view to eliminating the confusion caused by the use of local vernacular names, more especially, in export and inter-Provincial trade and in publications.

* * *

League of Nations: Technical Commission on Nutrition.—The *Bulletin of the Health Organisation* (Aug. 1938, 7, 4), recently issued, includes the report by the special committee which met in Geneva from August 22nd to 24th, 1938. The Sub-Committee dealt with the guiding principles for the study of the diets and nutrition of populations. Its work in this field resulted in the preparation of a handbook for use in surveys.

The Sub-Committee also noticed the special considerations which arise in connection with nutrition in the Far East, tropical countries and colonial territories. It referred in particular to the necessity of making a closer study of the nutrition value of local foodstuffs and the incidence of diseases directly or indirectly due to dietary deficiencies.

In this connection, the Sub-Committee submitted a programme of studies which, it is hoped, will be organised in 1939 with the assistance of the Nutrition Research Laboratories, Coonoor (India).

Lastly, the Sub-Committee's attention had been drawn to the fact that critical situations exist, even in Europe, where emergency measures are urgently required for famine relief. Its report contains simple and very inexpensive diets sufficient to maintain life and to prevent serious malnutrition. These diets include cereals, milk (whole milk or skim-milk), yeast, cod-liver oil and various salts, so as to provide the necessary vitamins and inorganic elements.

* * *

***Chronicle* of the Health Organisation.**—The Health Organisation branch of the League of Nations which has been issuing a number of publications, relating to subjects which come under its purview, has felt the need for a periodical publication which would keep members of the Organisation's commissions, its various collaborators, doctors, scientists, public health specialists, health departments, scientific institutions and medical reviews and publications, informed of the essential day-to-day activities of the Organisation. After a trial, which proved conclusive, the Health Committee decided to issue the *Chronicle*, the first number of which we have just received. It will appear twice a month and is intended to give an account of the work in progress and to provide informative matter in as succinct a form as possible. The first number contains a report of the recent work of the Permanent Commission on the Biological Standardisation, with regard to anti-toxins and sera. The annual subscription for the *Chronicle* is 5*sh.*

* * *

Heavy Chemical Industry in India.—Tata Sons, Ltd., have started a new venture in the Indian Chemical Industry by the manufacture of heavy chemicals in the Baroda State for which the State will give special facilities. The authorised capital of the enterprise is Rs. 5 crores. 1¼ crores will be issued at present.

The company will set up its works near Port Okha which belongs to the Baroda Government, which, besides granting valuable concessions, will subscribe shares to the extent of one-fifth of the present issue. Although the initial programme of the company is confined to the manufacture of basic heavy chemicals such as soda ash and caustic soda, the company contemplates the gradual development of the undertaking so as to embrace practically the whole field of production of heavy chemicals and fertilisers as well as special chemicals for use in industries such as pharmaceutical and photographic.

The scheme is being undertaken after two years of patient and careful preparation and thorough examination at the hands of British, American and other experts, who have satisfied the promoters as to the possibility of working it successfully. (*The Chemical Age*, 1938, 39, 531.)

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At the fifteenth annual general meeting of the **Indian Chemical Society** held on the 7th January at Lahore, the following were elected Office-bearers for 1939:—

President: Dr. H. K. Sen; *Vice-Presidents*: Dr. S. S. Bhatnagar, Dr. P. Neogi; *Hon. Secretary*: Dr. P. K. Bose; *Hon. Treasurer*: Dr. A. C.

Sircar; *Hon. Editors*: Dr. J. N. Ray, Prof. P. R. Ray; and *Hon. Auditors*: Mr. P. C. Nandi, Mr. T. K. Roychaudhury.

* * *

The Entomological Society of India.—The first annual general meeting of the *Entomological Society of India*, was held on the 4th January 1939 at Lahore during the 26th Session of the Indian Science Congress. The following Office-bearers were elected:—

President: Khan Bahadur M. Afzal Husain (Lahore); *Vice-Presidents*: Dr. Hem Singh Pruthi (New Delhi) and Dr. T. V. Ramakrishna Ayyar (Coimbatore); *Secretary and Treasurer*: Dr. K. B. Lal (New Delhi); *Joint Secretary*: Dr. K. D. Baweja (Lyallpur); *Members of the Executive Council*: Dr. N. C. Chatterji (Dehra Dun) and Dr. Khan A. Rahman (Lyallpur); *Editorial Committee*: Dr. Hem Singh Pruthi (Chief Editor), Dr. T. V. Ramakrishna Ayyar, Dr. N. C. Chatterji, Dr. D. R. Mehta, Dr. Khan A. Rahman and the General Secretary (*Ex-officio*).

It was decided to publish an entomological journal from the current year, to be called the *Journal of the Entomological Society of India*. The Office of the Society for the next four years will be located at the Imperial Agricultural Research Institute, New Delhi.

* * *

The Indian Botanical Society.—At the Annual General Meeting of the Indian Botanical Society held at Lahore on 7th January 1939, the following persons were elected Office-bearers for the year 1939:—

President: Rai Bahadur Professor K. C. Mehta (Agra); *Vice-Presidents*: Mr. H. G. Champion (Nainital) and Dr. H. Chaudhuri (Lahore); *Secretary*: Professor Y. Bharadwaja (Benares); *Treasurer*: Professor M. O. P. Iyengar (Madras); *Executive Council*: Professor S. P. Agharkar (Calcutta). Dr. K. Biswas (Calcutta), Professor S. R. Bose (Calcutta), Professor T. Ekambaram (Madras), Professor S. L. Ghose (Lahore), Dr. E. K. Janaki Ammal (Coimbatore), Dr. A. C. Joshi (Benares), Professor J. H. Mitter (Allahabad), Professor P. Parija (Cuttack), and Professor B. Sahni (Lucknow).

Professor F. E. Fritsch, F.R.S., and Professor A. H. R. Buller, F.R.S., were unanimously elected as Honorary Members of the Society.

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Indian Committee of Phytosociology and Geobotany.—At a meeting of the Botany Section held on 7th January 1939 at Lahore, a Committee consisting of the following members was appointed to consider the question of the formation of an Indian Committee of Phytosociology and Geobotany and place recommendations before a joint meeting of different sections at the next meeting of the Congress to be held at Madras in 1940.

Members of the Committee: Prof. S. P. Agharkar (Calcutta), Dr. N. L. Bor (Dehra Dun), Dr. F. R. Bharucha (Bombay), Secretary.

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Benares Hindu University.—Mr. G. K. Das, M.Sc. (Benares), has been awarded the degree of D.Sc. in Physics by the Benares Hindu University in consideration of his theses on (1) the Doppler Effect of Positive Rays of Hydrogen and its correlation with the Velocity of the Light-emitting Atoms: and (2) the Doppler Displacement with Positive Rays of Mercury.

The research incorporated in these theses was carried out under the supervision of Prof. Dr. Dasannacharya, in the Physics Laboratory of the Benares Hindu University. The theses were examined by Prof. Dr. J. Stark, Nobel-laureate, and Director of the Reichsanstalt for Physik und Technik, and Prof. Dr. E. Rüchardt of the University of München.

* * *

University of Mysore.—I. *Examinations*: The results of the Pre-Medical and M.B.B.S. examinations held in December 1938 were published. They were as follows:—

		No. Examined	No. Passed
1.	Pre-Medical ..	29	10
2.	I M.B.B.S. ..	25	13
3.	II M.B.B.S. ..	29	19
4.	Final M.B.B.S. Part I	21	14
	,, Part II	28	14

II. *Lectures.*—(*a*) The Appu Rao Extension Lecture, 1938-39, was delivered by Rajadharmapravina Diwan Bahadur Mr. K. S. Chandrasekhara Ayyar, B.A., B.L., retired Chief Judge, Mysore High Court, and Chairman of the Committee on Co-operation in Mysore, on "Co-operation as a Constructive Force" at Bangalore. (*b*) The following lectures were delivered under the Scheme of Extension Lectures during the month:—(*i*) Miss J. M. Black, M.A., Principal, Maharani's College, on "Trends of the Modern English Stage" in English at Bangalore. (*ii*) Mr. P. Kodanda Rao, M.A., Servants of India Society, Poona, on "A View of Civilization" in English at Mysore. (*iii*) Sri. B. Indiramma, M.A., Superintendent, Maharani's Women's Training College, Mysore, on "The Need for the Study of Educational Psychology by Parents" in Kannada at Kolar.

III. *Meeting of the Academic Council.*—A meeting of the Academic Council was held on the 30th January 1939. Among the propositions that were passed, mention may be made of the following:— (1) Holding the final examination for the M.B.B.S. degree twice a year. (2) Institution of Geography as an optional subject of study in the Intermediate and Degree courses. (3) Appointment of a committee to review the working of the course of studies and scheme of examination for the Intermediate and to make suitable recommendation for changes, if necessary. (4) Commencement of the University Session on the 1st June instead of on the 24th and holding University examinations in February–March instead of March–April.

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University of Bombay: Royal Institute of Science.—(1) Principal G. R. Paranjpe has been elected a member of the Council of the Indian Science Congress Association. (2) Dr. N. R. Tawde, of the Physics Department has been elected a Fellow (F.Inst.P.) of the Institute of Physics, England. (3) Dr. S. Parthasarathy, an ex-student, has sailed for Sweden to do research work, being awarded a Fellowship by the Nobel Institute, Stockholm. (4) Dr.

F. R. Bharucha has been given further grant by the Bombay Pinjrapole to continue his work on the improvements in grasslands. He is a member of a Committee of the Botany Section of the Science Congress to consider the formation of the Society of Phyto-sociology and Geo-botany.

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Professor F. T. Brooks, F.R.S., Head of the Department of Botany, Cambridge University, has been appointed a Special Reader of the University of Calcutta.

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Dr. R. S. Thakur has been appointed officer-in-charge of the Industrial Survey of Central Provinces and Berar. He has also been appointed a member of the Industrial Survey Committee and also its *Secretary*. Mr. J. C. Kumarappa, B.A., F.S.A.A., who is the organiser and Secretary of the All-India Village Industries Association, Wardha, is the Chairman of the Committee.

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Announcements

The Fifth International Congress for the Unity of Science at Harvard University.—The Fifth International Congress for the Unity of Science will be held at Harvard University from September 5 to 10, 1939.

The theme of the Congress is "The Logic of Science"; interest will centre upon the relation of the concepts, laws and methods of the various sciences. Attention will be devoted to general problems connected with the unification of science, and in particular, with the logic of the physical sciences, the relation of the physical and biological sciences and the relation of the biological and socio-humanistic sciences. There will also be a number of special sessions and symposia connected with special problems and fields.

Professor P. W. Bridgman is the Chairman and Dr. W. V. Quine is the Secretary of the Committee of Arrangements at Harvard University. The Congress is sponsored by the International Committee of the Congress for the Unity of Science, by the International Institute for the Unity of Science, and, in America, by the American Association for the Advancement of Science, the Philosophy of Science Association, the Association for Symbolic Logic and the American Philosophical Association.

A series of twenty monographs entitled "Foundations of the Unity of Science" (and constituting the first two volumes of the "International Encyclopedia of Unified Science"), is now being issued by the University of Chicago Press. It helps to provide a background for the Congress. Three monographs have already appeared, and it is hoped that all the twenty will be in print by the time of the opening of the Congress.

Further information regarding the Congress can be had from Professor C. W. Morris, University of Chicago, Chicago, Illinois.—(*Science*, 1938, 88, 519).)

10th International Congress of Military Medicine and Pharmacy.—The organisers of the Congress have since issued an illustrated booklet regarding the Congress, giving the history of the Congress since its first meeting in Brussels (1921), the programme of the meeting, general information to delegates, and short accounts on Washington, the headquarters of the Congress, the Army Medical Centre, the Naval Medical Centre and the Medical Field Service School. The questions to be discussed at the Congress are (1) The organization and function of the Medical Services in Colonial Expeditions, (2) Probable casualties in War and methods of calculation, (3) Practical procedures for Anaesthesia and Analgesia in War Surgery, (4) Organization and function of the Military Chemico-Pharmaceutical Service, (5) Emergency treatment and primary apparatus for fractures of the jaws in War, (6) Technical specialization of administrative officers in the medical service, and (7) Oxygen therapy and its practical use with troops on active service.

University of Bombay.—Applications are invited for the post of *Reader in Chemical Engineering* in the Department of Chemical Technology in the scale of Rs. 400–30–550.

Six typewritten copies of the application, made on the prescribed form, together with six copies of certificates, should be forwarded so as to reach the Registrar, University of Bombay, on or before the 1st March 1939.

The name of Mr. Gouripati Chatterjee has been inadvertently omitted in the list of the New Year (1939) awards announced in the previous number of *Current Science* (January 1939, 8, 42). Mr. Chatterjee is the recepient of the *Rai Bahadur* title.

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We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 50, No. 1.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 12.

"Journal of Agricultural Research," Vol. 57, Nos. 10–11.

"The Philippine Agriculturist," Vol. 27, No. 8.

"Biological Reviews," Vol. 14, No. 1.

"Communication from the Boyce Thomson Institute," Vol. 10, No. 1.

"Journal of the Institute of Brewing," Vol. 44, No. 12, and Index to Vol. 44; & Vol. 45, No. 1.

"Journal of Chemical Physics," Vol. 6, No. 12.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, No. 12, and Index; Vol. 72, No. 1.

"Chemical Age," Vol. 39, Nos. 1017–18; Vol. 40, Nos. 1019–21.

"Chemical Products," Vol. I, Nos. 2 and 3.

"Experiment Station Record," Vol. 79, No. 6.

"Transactions of the Faraday Society," Vol. 34, No. 213.

"Indian Forest Records" (New Series), Vol. 1, No. 7.

"Forschungan und Fortschritte," Vol. 15, Nos. 1–3.

"Geological, Mining and Metallurgical Institute of India," Vol. 34, No. 3.

"Bulletin of the University of Illinois," Vol. 35, Nos. 101 and 102.

"Communications from the Kamerlingh, Onnes Laboratory of the University of Leiden," Nos. 248–50.
"Bulletin of the Health Organisation of the League of Nations," Vol. 7, Nos. 4 and 5.
"Bulletin of the American Meteorological Society, Vol. 19, Nos. 8 and 9.
"Reviews of Applied Mycology," Vol. 18, No. 1.
"American Museum of Natural History," Vol. 43, No. 1.
"Nature," Vol. 142, No. 3609; and Vol. 143, Nos. 3610–12, and Index to Vol. 142.
"Journal of Nutrition," Vol. 16, No. 6; and Vol. 17, No. 1.
"Research and Progress," Vol. 5, No. 1.
"Sky," Vol. 3, No. 3.
"Canadian Journal of Research," Vol. 16, No. 11.
"Journal of the Royal Society of Arts," Vol. 87, Nos. 4492–96.
"Science Progress," Vol. 33, No. 131.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 7, Part IV.
"Proceedings of the Royal Academy of Netherlands, Amsterdam," Vol. 61, Nos. 7 and 8.

Catalogues

"Recent Books and New Editions of Standard Works on Chemistry," Messrs. Chapman & Hall, Ltd., London.
"Monthly List of Books on Natural History and Science," January 1939. Messrs. Wheldon & Wesley, Ltd., London.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

January 1939. SECTION A.—S. RANGASWAMI AND T. R. SESHADRI: *Fixation of the Aromatic Double Bonds in the Chromones.* S. RANGASWAMI AND T. R. SESHADRI: *7-Hydroxychromone-8-aldehydes and their conversion into chromono-7 : 8-α-Pyrones.* G. V. L. NARASIMHA MURTI AND T. R. SESHADRI: *The Behaviour of Organic Solids on the Surface of Water.*—The influences of the various groups $-COOH$, $>C=O$, NH_2, etc., in a substance on its behaviour on the water surface are discussed. B. R. SETH: *An Application of the Theory of Finite Strain.* S. CHOWLA: *A Remark on* g(n). P. SURYAPRAKASA RAO, V. D. NAGESWARA SASTRI AND T. R. SESHADRI: *Reactivity of the Double Bond in Coumarins and Related Unsaturated Carbonyl Compounds. Part VII. Action of Mercuric Acetate on Hydroxy and 4-Methyl Coumarins.* S. S. PILLAI: *On Waring's Problem with Powers of Primes.* S. RAMACHANDRA RAO AND A. S. NARAYANASWAMI: *Diamagnetism of Some Organic Liquid Mixtures.*—Mixtures of polar liquids have been studied. The derivations from additivity in the case of magnetic susceptibility is much less than in the case of density and refractive index. R. VAIDYANATHASWAMI: *On Continuous Functions of a Real Variable.* S. DUTT: *Chemical Examination of the Essential Oil of* Ocimus sanctum *Linn.*—The essential oil of *Tulsi* contains over 71% eugenol and 20% eugenol methyl ether, with 3% of carvacrol. B. N. SINGH AND N. K. ANANTHA RAO: *A Photo-Electric Nephelometer for Chemical Analysis.*—The intensity of scattered light from an illuminated column of turbid medium is measured by comparison with the light scattered from a standard of turbidity (frosted glass). S. S. BHATNAGAR, M. B. NEVGI AND G. L. OHRI: *The Diamagnetic susceptibilities of Mercury in Various States of combination.*—It is curious to note that the susceptibility constants from the inorganic compounds are different from those derived from organic compounds. The latter closely correspond to those which are obtained for liquid mercury.

January 1939. SECTION B.—B. SAHNI: *The Relation of the* Glossopteris *Flora with the Gondwana Glaciation.* C. VIRIKKI: *On the occurrence of similar spores in a lower Gondwana Glacial Tillite from Australia and in Lower Gondwana Shales in India.* S. N. DAS GUPTA AND G. S. VERMA: *Studies in the Diseases of* Mangifera indica *Linn. I. Preliminary Observations on the Necrosis of the Mango Fruit with special reference to the external symptoms of the disease.* G. N. RANGASWAMI AYYANGAR AND D. S. RAJABHOOSHANAM: *A Preliminary Analysis of the Panicle Structure in Sorghum—the Great Millet.* S. B. KAUSIK: *A Cytological Study of* Scœvola lobelia *Linn.* KAILASH CHANDRA MISRA: *A Contribution to the Embryology of the Verbenaceæ.* R. GOPALA AYYAR: *On the Nephridia of* Prionospio cirrifera *Wiren.*

Botanical Society of Bengal:

January 21, 1939.—ROY BASUDEV: *Pollination Studies in prunus.*—These studies carried out at the John Innes Horticultural Institution, Merton, London, reveal (1) In the self-incompatible Cherry, "Noir-de-Schmidt", treatment of the styles with the growth-promoting substances (phenyl acetic acid, naphthol acetic acid and indol acetic acid) has no effect on pollen tube growth. (2) In the self-incompatible plums "Coes Golden Drop", when self-pollinated, the pollen tubes are arrested in the stylar tissue. (3) In compatible and partially compatible pollinations in some plum varieties, it was found that in addition to pollen tubes which travel the full length of the style and effect fertilisation, tubes also occur which are arrested in the stylar tissue indicating two pollen genotypes. (4) In *Prunus divaricata* (diploid) pollinated with *Prunus domestica* (hexaploid), 6 per cent. of fruits set and in the reciprocal pollination 15 per cent. of fruits reached maturity. (5) The rate of growth of a diploid pollen tube in a hexaploid style is more rapid than that of hexaploid pollen tube in a diploid style.

Meteorological Office Colloquium, Poona:

January 27, 1939.—MR. M. P. VAN ROOY: *Meteorological Organisation in South Africa.*

SUPPLEMENT TO CURRENT SCIENCE

Vol. VIII] INDIAN SCIENCE CONGRESS, LAHORE, 1939 [No. 2

Summaries of Addresses of Presidents of Sections

MATHEMATICS AND PHYSICS

President: DR. K. R. RAMANATHAN, M.A., D.Sc., F.N.I.

THE EARTH'S MAGNETISM AND THE UPPER ATMOSPHERE

DR. RAMANATHAN mentioned that the study of the origin of the earth's magnetic field began with Gauss's systematic attempt in 1839. Gauss had shown how the field could be divided into two parts, arising from causes within the earth and outside the earth respectively. He concluded that the permanent field arose mainly from causes within the Earth, but did not overlook the possibility that electric currents outside the earth, evidenced by auroral phenomena, might contribute to this field.

The permanent part of the Earth's magnetic field consists of a regular part which would arise from the terrestrial sphere magnetised to an intensity of ·074 units along an axis at 11½° to the rotational axis, and an irregular part which arises from an excess of intensity in regions where land predominates. The internal system accounts for 94% of the total field, and the rest arises from an external non-potential system. The permanent moment of the Earth has been slowly decreasing at 1/1500 of its value per year, and the magnetic axis is also slowly changing. The origin of these changes is uncertain.

Analysis of the variable part of the field shows, besides irregular changes, periodic changes following the sun and the moon, and also associated with the rotation of the sun and the sunspot cycle. Investigations of Schuster and Chapman connected the solar diurnal variation, which has a 12-hour period, with systems of electric currents in the upper air, and it was suggested that these currents were due to to an oscillatory motion of the air, ionised by solar radiation, across the Earth's magnetic field. The currents flowing according to this 'dynomo' theory have to be of the order of 6×10^4 to 9×10^4 amperes. The first attempt to connect these currents directly with the observed oscillations of atmospheric pressure at ground level presented difficulties with regard to their phase and the magnitude of the conductivity of the upper air where they flow. This conductivity had to be of the order of 10^{16} E.S. units, whereas, calculations based on electron densities of about 10^5 per c.c. at those levels, obtained from ionospheric measurements gave conductivities of the order of 10^{11} to 10^{12} E.S. units. Pekeris sought to solve the problem in terms of the free oscillation of the atmosphere, which, with a nodal surface at 30 km. height would have a period of 12 hours, coinciding with the observed period, and which would be maintained by daily solar insolation. At 100 km. height, this oscillation would have an amplitude 200 times that at ground level and the phase would be opposite. This removed the phase difficulty to a large extent, but the conductivity required yet presented difficulties. The next step was taken by Massey who showed that at the levels considered, an equilibrium ratio of 1 : 100 between electrons and negative ions would be set up, so that the preponderating ions, of relative mass, say 28 (N_2^-) would be primarily responsible for the conductivity. On these bases the 'dynomo' theory seems fairly adequate to explain the solar variations of the magnetic field. A further support arises from the observations that radio fadeouts have been associated with bright solar eruptions on the one hand and magnetic disturbances on the other. The inference is that the solar eruption sends a blast of radiation with resultant change of ionisation of the air, and this change is responsible for the fadeout as well as the magnetic change.

The lunar variation, about 1/5 of the solar variation in mean value is semidiurnal, and is associated with the tidal action of the moon over an atmosphere of varying conductivity and is influenced by sunlight.

Of the irregular variations of the Earth's magnetic field, the most important is the "magnetic storm". A magnetic storm has generally three phases. In the first, an impulsive change in H—usually an increase—is felt all over the Earth in 2 minutes, and is followed by oscillations. In an hour or two, the second or main phase begins, during which H diminishes rapidly over a period of 6–12 hours. Finally in the third phase there is a gradual return to normal lasting three to four days. The change may amount to over 20% of the normal value in moderate storms, and is greatest near the equator, diminishing towards the poles. Analysis of the field variations shows that the main source of disturbance lies outside the Earth. Birkeland put forward the view that this source is a system of currents in the upper air or outside it. According to this, the part of the current system located in the upper atmosphere, mainly in the auroral region, has a strength of 2 to 5×10^5 amps. and occurs in the region of highest conductivity, at a height of 100–150 km. The other part is a ring current with a diffuse maximum over the equatorial region. It is necessary to place this well outside the Earth's atmosphere, at a distance of a few earth-radii and its magnitude is estimated to be of the order of 10^4 to 10^5 amps. The theory of Birkeland and Stormer explains these currents as

due to streams of corpuscles from outside, presumably from the sun, moving towards the Earth and deflected in their paths by the Earth's field. In spite of many uncertain points waiting clarification when studied in exact terms, the main outlines of the theory appear reasonable. Another theory, based on the emission by the sun of a sudden blast of ultra-violet radiation whose effects on the atmosphere might produce the effects studied, has been advanced, but at present, it fails in many material aspects.

CHEMISTRY

President: DR. P. B. SARKAR, DR.ES.SC., A.I.C., F.N.I.

ANALOGY AMONG CHEMICAL ELEMENTS AND RADICLES

THE early portions of the Address are devoted to an elucidation of the causes of chemical similarity among elements. Illustrations are provided by comparison of the valency shells of thallium, silver and the alkali metals, to explain the chemical similarities and differences of the compounds of these metals.

Where the similarity exists only in the outermost electronic shell and the structure of the penultimate shell varies, there exist appreciable differences in properties.

The complete chemical analogy observed in the series of the rare earth elements is accounted for, on the basis of electronic structure. Considerable variation exists in their other properties such as basicity, paramagnetic susceptibility, absorption spectra and colour. The anomalous valency possessed by certain rare earths is of great practical interest and this principle finds application in the separation of cerium from other rare earths as a ceric compound, and of europium and ytterbium from other rare earths by means of their insoluble sulphates. A classification of the ions into six different types according to their structure reveals several interesting relationships.

The address then proceeds to deal with the properties of complex ions or radicles. Isomorphism is a criterion of chemical analogy but in addition to similarity in crystalline form, there should be ability for syncrystallisation.

The investigations of Goldschmidt regarding the connection between crystal structure and chemical and physical properties and the observations of Fajans regarding polarizability or deformation of ions are of profound help in explaining chemical analogy of radicles.

A short account is given of the investigations by Dr. Sarkar and his co-workers on the sulphate and the fluoberyllate ions. These two ions are isosteric and their charge is identical and so they are isoelectric as well. Their chemical analogy is illustrated in two tables giving their formulæ, Mol. vol. (30° C.), and ability to form mixed crystals.

The investigations of Lange on the PO_3F'' and SO_4'' ions established their close analogy. The stability of the three homologous complex ions decreases in the order $SO_4'' \rightarrow PO_3F'' \rightarrow BeF_4''$.

P. C. Ray's observation of isomorphism supported by mixed crystal formation of formates and nitrites is of great interest. The CH group in formic acid can be considered to be a condensed nucleus and equivalent to nitrogen atom in its behaviour.

The formulation of the electronic structure of the atom has rendered possible the discovery of many interesting relationships between elements and radicles which could not have been predicted from a consideration solely of the periodic table.

K. R. K.

GEOLOGY

President: DR. S. K. ROY, B.SC., PH.D.

CONSERVATION OF INDIA'S MINERAL WEALTH

IN his Presidential Address to the Geology Section, Prof. S. K. Roy deals with the important problem of the "Conservation of India's Mineral Wealth". In tackling this problem, he points out that "the first step is to know our resources—our national wealth in things and in their possibilities; the second step is to know their availability for immediate use; the third step is to guard them against waste, either through ignorance or wantonness; and the fourth step is to prolong their life by invention and discovery". After giving an account of the present unsatisfactory condition of mineral mining in India, Prof. Roy proceeds to consider the ways in which the proper conservation of our important mineral deposits should be accomplished. Talking first about the conservation of fuel, he deals with the two important mineral fuels found in India—Coal and Petroleum. Regarding coal, he refers to the findings of the recent *Coal Mining Committee*, and discusses the importance of the various recommendations they have made, especially as regards the necessity for 'sand-stowing' in coal mines, which not only solves the most important problem of safety in mines, but also helps in the conservation of coal. Immediate provision has also to be made in India for fuel research to prevent the enormous wastage of the by-products formed during the conversion of coal into coke. Talking of petroleum, Prof. Roy points out that its conservation is quite as important as that of coal at the present time, when we are living in an 'age of petrol'. India's total consumption of petroleum and its by-products is about 300 million gallons per year, and of this, only about 76 million gallons are produced in India. In view of this limited supply, it is obviously necessary to do all that we can to conserve our resources. He then refers to the several factors which now lead to various kinds of wastage in the oil industry, and makes several suggestions for improving the position, on the lines adopted by the leaders of the petroleum industry in the United States of America. In the latter part of his Address, Prof. Roy deals with the conservation of various other minerals of economic value, such as mica, chromite, magnesite, beryl, garnet, bauxite, wodfram, etc., and

also puts forward a plea for the revival of certain forgotten mineral industries in India.

For securing the proper conservation and utilization of India's mineral wealth, Prof. Roy urges the necessity for each Province in India having a geological department of its own manned by capable geologists and efficient mining engineers. As he points out, "Indian Universities, like those of Benares, Bombay, Calcutta, Madras, Mysore, and Punjab, as well as the Indian School of Mines, Dhanbad, are now-a-days producing very efficient and capable geologists qualified to take up the mineral investigations in our country", and the provincial governments can easily recruit their staff from among the young men coming out of these institutions. There is no doubt, that the organisation of such provincial geological departments all over the country will "eventually lead to the conservation of our mineral wealth, and to the re-opening of many deposits of the neglected and unknown minerals of India".

GEOGRAPHY AND GEODESY

President: N. SUBRAHMANYAM, ESQ., M.A., L.T., F.R.G.S.

THE GEOGRAPHICAL PERSONALITY IN INDIA

IN his Presidential Address to the Geography and Geodesy Section, which was constituted this year permanently into a separate section of the Indian Science Congress, Mr. Subrahmanyam has shown that India has an individual geographical personality of her own which is quite distinct from the others of the world.

While dealing with the Static Geography the President observes that the physical features, hydrosphere and atmosphere, have been favourable to India; they have made her self-sufficient and isolated. By this aloofness she has developed many commendable traits such as simplicity, toleration and spirituality, which have been helpful in stabilising the Indian civilization. This same isolation has been responsible for the many-sided variety in the habit, religion, food, etc. Thus constituted and provided by nature, India developed a level of civilization not behind that of the world from the earliest times till the 18th century. From the 18th century to the present day, while the West has been forging ahead, India has remained static—she has reached the bottom level of Statical Geography.

Under Dynamic Geography the President continues, by saying that India's place in the world politics is connected with that of the British Commonwealth, and world events affect her indirectly through the British relationship.

Under the non-political spheres, she has responded to the changes brought about by Science. Her village-life, caste, self-sufficiency, etc., have all been smashed, and many modern cities have sprung up attracting people from the villages. She has just started what other nations have already achieved by the aid of modern conveniences in bettering the conditions of her peoples.

The Industrial Revolution has brought about dislocation of the occupation of the sons of the soil. The old professions have been wiped out of existence by the new ones, which have not been able to absorb all the thrownouts. And, further, extensive production in India itself has added to the dislocation of the equilibrium.

Apart from cultural contacts of Hindus and Moslems seen in architecture, music and painting, the influence of the British could be traced in modern town planning, and in the evolution of different types such as ruler, businessman, planter, companies, etc., corresponding to British types. The Indian exercises have given place to British sports, and in fact, there is a strong tendency in her to modernize after the European model, in all walks of life.

The President remarks that any Britisher who comes to India does carry on the work to the profit of both countries and attributes, rightly, the lack of that spirit in Indians partly to the cultural lag. While dealing with the utilization of the wealth of India, he observes that it can be multiplied and applied to the reduction of poverty of her own people. The utilization of her resources is far from complete, and the Dayalbhag experiment in manufacturing marketable articles and Gandhiji's Khadi movement go to show that improvement in the utilization of wealth could be effected, and that the disabilities are more human than physical.

The President concludes his address by the following remarks: "The old Static Geography sees only the pressure upon land, the appalling poverty, etc., of an improgressive India. The new Dynamic Geography can see the forces at work, and disengage the true causes from the false. It finds that the causes are not inherent but removable; that man in India has fallen behind and is catching up; only he has not, as yet, risen to the height of his opportunities.... Here, in India all the cultures of the world meet, in all their variety and range; and a great composite civilization is growing under the influence of them all. Therein will lie the diversity, richness, comprehensiveness and greatness of the Indian civilization that is to be".

S. L. R.

ZOOLOGY

President: PROF. C. R. NARAYAN RAO, M.A.

BATRACHIANS AND THEIR ENVIRONMENT

PROFESSOR C. R. NARAYAN RAO'S address is based on the data accumulated by his faunistic studies of the batrachians of S. India, and is an exposition of the interrelations of the environmental complex and their general morphological organisation, producing marked effects on somatic and genetic variations. Ecological communities of amphibians can be recognised which resemble each other superficially in correspondence with resemblances between their environment. The tailless amphibians inhabiting the rain forests of the different parts of S. India are reported as exhibiting a whole series of obvious resemblances, among which adaptational modifications for climbing, burrowing, crawling and for parachute leaping are especially noteworthy. Batrachians and their

larvæ affecting the rapid hill streams where they periodically encounter floods, have developed adhesive discs for firm attachment to rocky surfaces or as in the case of larvæ are provided with organs of flotation as well. According to Professor Rao the necessity for definite adaptational devices operating upon this plastic group of lowly organised animals form a sort of wicket gate through which only forms possessing similar adaptations can pass, thus giving rise to common morphological features of batrachians living under more or less similar environmental conditions. The warm air saturated with moisture in the tropical forests renders the ghats an ideal place for the occupancy of amphibians and the physiological influence of factors such as the varying amplitudes of temperature, humidity, intensity of light, air pressure, food, and the presence or absence of plants, produces significant regulative modifications both in the character of structural organisation and general habits. To illustrate the extent of such modifications, the common toad and the common water frog, which occur in the plains and which have extended into the deeper regions of forests and the summits of the higher ranges of hills, have been selected and the limits of variations have been noted. There is an astonishing profusion of amphibian life in these regions, and the members of the different groups present common characters and common habits which have resulted under the influence of common environmental factors, and Professor Rao indicates that so close is the correspondence that without recourse to anatomical examination their classification offers perplexities. According to him ecological studies of amphibians in their morphological and physiological aspects throw considerable light on the problems of their taxonomic relationships, rendered complicated by the frequent occurrence of interbreeding among the members of the different genera and by the presence of hybrids closely intermingling with the natural species. The suggestion is made that spatial distribution of the members of an original stock into regions totally different in physical characters, aided by the process of selection, may be presumed to be the stimulating factor in the evolution of new species.

ANTHROPOLOGY

President: Dr. D. N. Majumdar, M.A., Ph.D., F.R.A.I.

TRIBAL CULTURES AND ACCULTURATION

In his introduction, Dr. Majumdar refers to the imperfections of the monographic treatment of cultures in transition; to the discomforts of primitive communities and to the need of administrations employing trained anthropologists to study the adaptive processes among men of simpler cultures. The main thesis of the address is a discussion of the importance of cultural contacts, the effects of such contacts on primitive institutions and of the blending of cultures with one another to form new complexes. In the presence of an alien culture, relatively backward groups adopt, selectively, some of the traits of the former, which process is called *acculturation*. Geographical juxtaposition leads to co-operation, social commensalism, and ultimately to cultural miscegenation with new planes of integration.

The area selected for the study of *acculturation* is the State of Bastar in the Central Provinces with aboriginal Gond tribes and immigrant groups from the surrounding districts who have more or less mixed with the former. *Halbi* (an Aryan dialect) is the *lingua franca* of the State, but various Dravidian tongues, dialects of *Gondi, Telugu*, etc., are spoken by the different tribes. The highest in social gradation are the Rajput Dhakars, descendants of the Kshatriyas who originally followed the ruling family to Bastar. These immigrants used to add to their numbers through the custom of *ghaita pani* (family rehabilitation) and by taking to tribal women. The Halbas who have given their name to the common language of the State, are a mixture of foreign and aboriginal blood, and outsiders are still admitted to their ranks. The Halbas represent the plastic state of local culture. The Marias of Abujmar Hills are the rudest of the tribes and have not yet begun generally to participate in the economy and culture of the rest of the people of Bastar. Some of the wild Marias have settled in the plains and are known as Dandami or Bison-head Marias, while those who have been still more modified are known as Murias. Druvas, known otherwise as Parjas, are tribal groups that have adopted Uriya as their mother-tongue. The very numerous Bhatras are immigrants, hinduised and with sacred threads. Certain other groups such as Panra, Sunri, Kalhar, Rawat, and Kurukh are only functional and numerically small. The coming in of foreigners and the introduction of money economy have weakened the solidarity of the aborigines and at the same time reduced many of them to serfdom under employers of the immigrant groups. The administration of the State is trying to counteract this tendency, but under existing economic conditions, it is doubtful if these efforts will succeed.

Next is described at some length the *gotul* or communal dormitory which is an indigenous institution serving a variety of needs. It is a kind of club of adolescents of both sexes where they receive informal education in arts and crafts, tribal codes, sex behaviour, etc. Whatever be the origin of the *gotul*, it survives, as it has a definite rôle in the economy of tribal life.

The manner in which all the various sections of the people of Bastar, immigrant and native, high and low, are getting integrated into a greater community is illustrated in the religious rites, division of labour, prerogatives, etc., in connection with the celebration of the Dusserah festival in honour of the goddess Dantesvari, the tutelary deity of the ruling family of Bastar. Every group has its contribution to make to the rituals. Contrasting the manner of participation in religious rites by interior and exterior castes of S. India on the one hand and the immigrant and indigenous groups in Bastar on the other, Dr. Majumdar says, "While in the

South the economic partnership between primitive and backward groups has been regarded as essential but no serious attempt has been made to bring together the different groups into a common religious fold, in Bastar the fact of their cultural difference has been forgotten and there is one festival for all in which rites and customs of primitive and advanced cultures have blended together."

A. AIYAPPAN.

AGRICULTURE

President: DR. T. V. RAMAKRISHNA AYYAR, B.A., PH.D.

INSECTS AND THEIR RÔLE IN INDIAN AGRICULTURE

OVER 60 per cent. of the known living species of animals in the world are found to be insects. No single group of animals plays such a prominent and important rôle in a variety of ways with regard to the agriculturist, the grocer, or the stock breeder, as insects. The rôle that insects play in agriculture is the most important of all, as enormous loss is caused to growing crops and the farmers suffer heavy losses.

According to the very modest calculation of the President, the extent of damage caused to the Indian agriculturist is 200 millllion rupees per year due to the ravages of insects on a few of the important crops, *viz.*, rice, wheat, sugarcane, cotton and oil-seeds. Other serious wholesale losses by plagues of locusts, hairy caterpillars, bugs, beetles, etc., have not been taken into consideration.

A few paragraphs in the address are devoted to pest outbreaks and factors influencing them, nature and range of insect injury, incidence. Importance of supplying the farmer with information on noted pests and their incidence—a crop pest calendar—for some of the important crops, is emphasised. In the discussion on some of the insect problems connected with Agriculture in India, a pest survey of South Indian region alone reveals 535 insects in association with 125 plants. Although many of these are minor, some very important and noxious forms affecting crops are rightly termed the K.D.'s among Indian insects.

Among all-India and local insect pest problems, the periodical invasion of crops by locusts in North and Central India, the bollworm on cotton, insect pests of sugarcane, wheat, paddy, Deccan grasshopper, pests of plantation crops like coffee, cardamom, tea, rubber, pepper, etc., are mentioned.

Different methods of control of insect pests in India—from faith and magic cures of old to the modern methods of chemical, biological and legislative, are mentioned.

Among biological methods of insect pest control in South India mention is made about the present work in Mysore on the control of sugarcane borers—a serious pest of sugarcane throughout the cane-growing tracts in India—by means of breeding in the laboratory, millions of the well-known natural enemy (*Trichogramma minutum*) a very minute wasp and their large-scale releases in the cane fields. Mention is also made about the more or less complete wiping out of what was once a very noxious weed in South India, *viz.*, Prickly pear (*Opuntia*) by means of the introduction of scale insect (*Dactylopius*), which destroyed the plants wholesale within a few years after its introduction. Among chemical methods of controlling insect pests, although insecticides used to fight pests infesting valuable and well-paying crops like fruit trees, cotton, tobacco, etc., are quite practical and economical, the use of these insecticides by the Indian agriculturists for staple food crops like paddy, millets, etc., that give only poor returns, is quite impracticable and uneconomic. Mention is made here about the investigations in Mysore about local readily available vegetable insecticides for the control of insect pests.

Before concluding, the President makes some observations on the existing conditions and suggestions regarding the future Economic Entomology in India.

The organisation for work on economic entomology all over India should be increased and intensive work should be done on the subject of crop pests on the following lines:—

1. Study of the bionomics of crop pests from their entomological side.
2. The relation of climate and weather conditions to insects. Co-operation of economic entomologists with other workers in allied sciences, *viz.*, mycologist, plant breeder, biochemist and agriculturist is emphasised.

The address concludes by pointing out to all interested in agricultural prosperity of our land that the insect problems of the Indian farmer are increasing day by day and it is up to Governments and the educated farmers to do all that should be done to save the numerous valuable products of the country from the clutches of noxious insects.

T. V. S.

PHYSIOLOGY

President: MR. N. M. BASU, M.A.

PHYSIOLOGICAL RESEARCH IN INDIA

IN his Presidential Address Prof. N. M. Basu lays emphasis on the need for giving an impetus to the study and research in physiology. Whilst deploring the present difficult circumstances in which physiology is taught in the Indian Universities, the President makes a strong appeal in favour of establishing an organization for research in physiology. He surveyed very rightly too, the progress of research in physiology in India, and indicated the main lines on which research may be carried on.

Prof. Basu anticipates that on the establishment of an organization for research in physiology, the subject will be as "intellectually responsible as physics, mathematics and chemistry and men of really first class ability will be attracted to it". The Presidential Address ought to command the earnest attention of all interested in the study and development of research in physiology.

A. S.

PSYCHOLOGY

President: H. P. MAITI, M.A.

DYNAMIC STRUCTURE OF THE HUMAN PERSONALITY

PSYCHOLOGY OF PERSONALITY

THE Presidential Address of the Psychology Section of the Indian Science Congress (Twenty-sixth Session, Lahore, January 1939), was delivered on the 6th January, by H. P. Maiti, M.A., who has endeavoured to focus attention on the Psychology of Personality and on the vicissitudes of the development of the concept ever since the recognition of the claims of psychology to rank as a scientific discipline. Observing that Functionalism did not supply an adequate explanation of "personality as a whole", (p. 2) Mr. Maiti refers to Behaviorism which has come to stay in any classification of modern sciences. Janet's differentiation of the types Psychasthenic and Hysteric, though helpful, did not disclose the "mechanism of personality integration". In America and Germany, Personality Tests have commenced their career of experimentation *a la* the Intelligence Tests, and Mr. Maiti refers to "three current Personality Tests", namely, Extraversion, Intraversion; Cyclothymic and Schizo-thymic; and Eidetic types. Emphasizing the need for a revised, dynamic conception of personality, Mr. Maiti recognises the part played by the Gestalt Psychology and suggests that Functional Analysis, *i.e.*, "correlated variation of function in actual working" (p. 5) would be a suitable method.

Proceeding, Mr. Maiti refers to Freud's Id, Ego, and the Super-Ego, and observes that the "main purpose of this discourse is to emphasize that the three factors in their mutual interaction may be said to constitute the fundamental scheme of personality....". (p. 7) The dynamic view of personality is correlated, in the second section of the address, with the general theory of learning. Having explained the nature of animal intelligence, Mr. Maiti goes on to sketch the development of Human Personality, explaining the stages marked by the inadequacy of organic intelligence, clash and conflict with social environment and the origin of the Super-Ego. In the third section conclusions are indicated and results summed up.

In the concluding section, Mr. Maiti has indicated patterns of behaviour grounded on patterns of personality in reference to the tripartite of Id, Ego, and the Super-Ego. Behaviour normal and abnormal, is explained on the basis of the triad. Mr. Maiti ends on a note of optimism. Psychological sublimation of the unhealthy manifestations of the Id, and the Ego would seem to guarantee the advent of the millennium.

From the foregoing summary of Mr. Maiti's presidential pronouncement, it must be pretty obvious that *two* conclusions emerge: (1) The first is that no static conception of personality would be adequate to do justice to the psychological data and interpretation thereof relating to personality. (2) The second is that equilibrium or harmonization among the Id, Ego, and the Super-Ego would indicate a normal personality. It follows that a disturbance of the equilibrium indicates abnormal personality.

I have no doubt students of psychology will feel thankful to Mr. Maiti for having emphasized the dynamic character of personality, but, I am afraid he is just carrying coals to Newcastle, in respects of those acquainted with the conclusions of Indian Psychology on the subject-matter of personality. The strictly psychological or para-psychological quest of the nature of personality or self, free from pre-occupations pre-eminently physiological, anatomical, neurological and clinical *is yet to be*. American and European Psychology may never rise above Behaviorism reducing personality just to a sum-total or summation of reactions to environment. Totalitarian politics at one extreme, with severe suppression of the claims of individual personality, and democratic politics with free-vote of personality at the other, notwithstanding their apparent opposition in political ideology and governmental methodology are just species of one and the same genus of Behaviorism!

That outlook will have to be abandoned sooner or later. Indian Psychology makes out that personality is identity-in-difference, unity-in-multiplicity, one-in-many, static-in-dynamic. The differentiation of aspects of the mind, (Manas) the inner-sense into Manas, Buddhi, Ahamkara, and Chitta, and the recognition of Atman as the core of personality would lift Indian Psychology above the chaos and confusion concomitant with the Id, the Ego, and the Super-Ego. I have permitted myself the foregoing observations, simply because, Indian Psychology has a place in the sun.

R. NAGA RAJA SARMA.

Triplicane, Madras,
February 6, 1939.

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The Relation of Universities and Research Institutes to Industrial Development

IN the Report of the Chemistry Research Board of the British Government Department of Scientific and Industrial Research for the triennial period ended 31st December 1937, the following statement is made in the Introduction to the Report of the Director of Chemical Research:

> "During the last 3 years some 20 members of the staff in various grades have resigned to take up responsible positions in Industrial organizations dealing with different branches of chemical manufacture."

In contrast with this may be mentioned a reply given by the Director of the Government Test House, Calcutta, when the remark was made to him that no doubt many of their workers found positions in industrial concerns. The Director's reply was: "On the contrary, we have a number of applications from men holding positions in industry to be taken on to the Research staff at the Test House." This contrast would appear to be significant and to reveal conditions wherein the state of industry in India differs markedly from what exists in England. In the first place, it would seem that the young Indian scientific worker prefers the quiet atmosphere of a Research Laboratory—whether scientific or technical—to the more adventurous existence in an industrial concern. The fact that much of the Research work of the Industrial Research Bureau is carried out at the Alipore Test House would no doubt also add the attraction of Government service to even a humble position. Moreover, in many cases a University graduate will find the surroundings of a factory in India uncongenial after the peaceful atmosphere of the University or the Research Institute laboratory. He will often find no doubt that there is not much scope at present for his academic attainments. It does not require great scientific knowledge, *e.g.*, to notice where steam is escaping from faulty flanges, or where an appreciable percentage of the product of the factory finds its way on to the floors from leaky containers, but it is just this faculty of what was termed by a lady speaker at the Silver Jubilee Meeting of the Indian Science Congress "good house-

keeping", which is a preliminary requirement of success in technical industry.

On the other hand, the desire for a quiet life in a scientific atmosphere is very different from the urge which, we are told, led young W. H. Perkin to leave his Assistantship in the laboratory of the great Hoffmann in order to make a supply of his new mauve dye and to become a somewhat unsuccessful commercial traveller among the calico printers of Scotland, and finally to persuade his father to build a works and to evolve suitable processes and plant, in the first place, for the manufacture of aniline, though he (Perkin) had never been inside a chemical works before. A whole series of other difficulties—chemical and mechanical—had to be overcome before the dye industry was established and Perkin was free after 16 years to go back to his beloved scientific laboratory.

In another field of technical enterprise it is related that one of the members of the "Big Five", responsible for the installation of the "Grid" in England, in the early days of his career was so determined to become a mechanical engineer that he signed on in the engine room of a cargo steamer and braved the horrors of sea-sickness—he was a bad sailor—in order to acquire the real competency which is only to be gained by actual contact with day-to-day difficulties.

It is possible that the reason why engineers often hold more responsible positions in technical industry than do chemists is because in a majority of cases, hard workshop practice, necessitating early morning hours and the wearing of overalls, is part of the customary training of an engineer. Sir P. C. Ray has more than once spoken very frankly about the special disabilities of Indian University graduates. Dr. H. E. Watson, in a recent letter to the present writer, mentions an under-graduate course designed to act as a connecting link between the Faculties of Science and Engineering in the University of London.

On the other hand, it is doubtful whether more than a limited number of industrialists in India really appreciate the possible advantages of the application of scientific knowledge to the operations of their factory.

There need not, however, be undue discouragement. The early records of the Indian Institute of Science show that the first members of the staff were very much concerned at the lack of practical laboratory competence on the part of many of the first students. They possessed a fair amount of book knowledge, but appeared quite incapable of handling even simple experiments in the laboratory. Since those days the outturn of reasonably well qualified graduates in chemistry and physics is more than sufficient to supply available vacancies. Nevertheless, the number of those who are really in a position to take responsible posts in industry, as apart from simple positions as analysts or subordinate supervisors is still small. Complaints are still heard of the lack of what may be termed "bench craft" on the part of the average University graduate. The lack of "machine sense" and of the capacity of making intelligible drawings is also remarked by responsible people.

It would seem likely that Indian scientific education has been somewhat circumscribed and one-sided. In the early days of what was then known as "technical education" in England, the need for which was awakened in the seventies by the phenomenal progress of Germany, the appeal was made to a rather wider public than has necessarily been the case in India. Great men like T. H. Huxley and Sir Henry Roscoe lectured to audiences of industrial workers and intelligent middle class amateurs, awakening an interest in the outstanding discoveries of the science of that time, and powerfully influencing the type of education to be introduced into the elementary and secondary schools then coming into existence. It was Huxley who emphasised the educative influence of drawing. The following is taken from a volume of his "Aphorisms and Reflections":—

"I do not wish to exaggerate but I declare to you that in my judgment the child who has been taught to make an accurate elevation, plan and section of a pint pot has had an admirable training in accuracy of eye and hand."

Unfortunately in India, although no one doubts the practical manual dexterity of the Indian workman and the intelligent fitter or mistry, these men are often illiterate while the educated graduate has not acquired the practical competence of the workman. The habit of taking verbatim notes of lectures goes far to kill the real faculty of assimilation. By contrast an incident related as having happened in the early days of the Manchester Technical School, later to grow into the Manchester College of Technology, may illustrate the point. A working man took his place in an evening class and prepared to listen to the lecture. He was reminded that he had not got a note book. "What would I want a note book for?", he said. "To write down what the lecturer says", he was told. "What should I do that for?" he asked. "In case you might forget". "Wot's me blinkin' 'ed for?" was his final and sufficiently crushing response. If the education in the primary and secondary schools and in the intermediate colleges is made less academic and the aspect of craftsmanship stressed at every stage it will not be so difficult for the University and the Research Institute to take up the problem at a later stage.

At this point the difference may be emphasised between the type of work which can be usefully carried on at a University as distinct from a Research Institute. The University is concerned with general education rather than specialist investigation, at any rate of an industrial type. Nevertheless the work done at the University can be of great importance in preparing the student for his future career in industry. The subjects of "bench craft" and drawing have already been referred to. In the later stages research work of an industrial bearing, which yet can be taken up in the University without serious alterations in the syllabus and equipment, has been indicated in an admirable paper published by Dr. T. S. Wheeler in the *Journal of the University of Bombay*, Vol. I, Part II, September 1932. Dr. Wheeler shows how the various types of chemical development research may be classified broadly as follows:—

1. Production of a new product.
2. Production of an existing product by a new process.
3. The improvement of an existing process.
4. The transference of a known reaction from the laboratory to the technical scale.

He goes on to show the fundamental characteristics of new processes, *viz.*, the ready availability of raw material and the control of external conditions particularly pressure, temperature and electrical external conditions. The problem of the transference of a known reaction from the laboratory to the technical scale is intermediate between the task of the University and of the Research Institute or the actual factory. Even here experiences which have been related by several of those who have delivered the Streatfield Memorial Lecture under the auspices of the Institute of Chemistry have testified to the success of the homely methods employed by Streatfield at the Finsbury Technical College to awaken "technical sense" amongst his students. Thus we are told that one of the exercises given to them was the distillation of 2 or 3 gallons of coal tar separating the various fractions and preparing specimens of as many substances as could be isolated. The distillation was carried out with a small scale iron retort in a room downstairs. Almost invariably a too rapid heating during the initial stages resulted in an uncontrollable frothing when the water began to boil. Streatfield did not forget to point out the moral which the necessary cleaning up made unforgettable.

In the University may, and should be instilled, those qualities of *character* which

are essential for success in any technical enterprise of moment. It is sometimes forgotten by the academically-minded that success in the honest development of a great productive business calls for qualities equal to or even more admirable than those developed by scientific research. This is rightly recognised in Government Honours Lists and even, of late years, by such a body as the Royal Society. It has been pointed out by responsible authority that the practical working out of a new process, while it may not result in many publications in scientific literature, yet calls for an equal or even greater truly scientific ability. Moreover, such work inevitably entails the development of the team-spirit, the need for which among scientific workers has been eloquently referred to in the Presidential Address of Dr. J. C. Ghosh before the Lahore meeting of the Indian Science Congress.

The importance of the cultivation of the *inventive* faculty has been stressed by the present writer in another connection.* How far opportunities for the cultivation of this faculty are multiplied will depend very largely on the experience and personality of the teacher. A danger which besets the graduate whose training is confined to the University is a tendency to a purely laboratory outlook. It has been fairly argued that in India owing to the fewness of manufacturing centres and the great distances between them it is very difficult for many University students to visit actual factories. With the modern development of the cinema it should be possible without too great expense to exhibit to even elementary classes, films illustrating fundamental technical processes more vividly than the old-fashioned diagram or model.

The Research Institute differs from the University in the fact that it is concerned as a rule with the study of a single industry or at most of one or two. It is, therefore, possible for much greater expenditure to be incurred in equipping the specialist department with the plant necessary to carry out technical work on a scale, at any rate approaching that of the actual factory. India has been fortunate in the multiplication of such Institutes of recent years, Iron and Steel can be studied at Jamshedpur, Fuel at Dhanbad, Sugar and Oil at Cawnpore, Electrical Technology at Bangalore and Lac at Ranchi. These centres are mentioned as being concerned with technological rather than techno-agricultural research such as the several institutions sponsored by the Imperial Agricultural Research Council.

Government has been criticized for not having shown the same generosity towards Technological Research as in the case of agricultural investigations. It would seem, however, that the work already done and still being pursued by the Industrial Research Bureau, working under the guidance of the Imperial Industrial Research Council, has not been sufficiently recognized. In the first place and at the outset of its work an admirable bibliography of industrial publications was compiled and is available at the Government Press. In addition, no fewer than 13 valuable Bulletins dealing with such subjects as the Indian Glass Industry, Manufacture of Photographic plates in India, the Development of Heavy Chemical Industries in India as well as several important aspects of the Oil and Soap Industry have been published. The Bureau, it may be remembered, has only been actively at work during less than 4 years. The laboratories of the Industrial Research Bureau are being continually extended and work of great importance is in progress concerned particularly with standardisation of manufactured articles, the testing of liquid fuels in engines, the study of the weather-resisting properties of paint products and the manuacture of dry cells. Important work has been undertaken in connection with the glass industry, involving the design and operation of a special furnace.

* Address to the Institution of Chemists (India) entitled: "Research and Invention" on 26th August 1938. *Proceedings of the Institution of Chemists (India)*, Dec. 1938, **10**, Pt. IV.

There is no doubt, however, that the work of the Bureau could be greatly developed if sufficient funds were provided to enable it to extend its area of usefulness in *liaison* with the Universities and the Research Institutes. In a recent lecture on Research in the Iron and Steel Industry, published by the Institute of Chemistry, Dr. W. H. Hatfield, F.R.S., gives a table showing the number of official organizations co-operating with the Research Council and Research Committees. There are nearly thirty of these organisations including four Universities and several University Colleges and a number of Professional Institutions and Research Associations.

It is doubtful whether it is fully recognized, either by those in financial authority or by would-be *entrepreneurs,* that the development of a new industry or even of a new process entails usually the expenditure of very large sums of money. Even those who were closely associated with Ludwig Mond in the early days of the Brunner-Mond Works at Winnington, Northwich, were sometimes almost appalled at the way in which he would scrap an expensive plant and build another if he saw that certain lines of investigation were not worth pursuing. The amount of money necessary to be expended before the simple laboratory apparatus, in which nickel-carbonyl was first prepared, could be developed into the plant of the Mond Nickel Company, must have been enormous. That is why even in the laboratory exercises of a University course, attention should be paid to the question of yield of product and the prevention of wastage at every stage. There is no doubt also that those who are to take their place in technical industry should, at some stage of their early career, have a fairly rigorous training in business methods and fundamental economics.

However near the technical laboratories of the University or the Technological Research Institute may approach to real factory conditions, they can never be a substitute for real experience in the actual world of industry. It is possible, however, although not always easy of accomplishment, to create as we have seen in the case of the Iron and Steel Industry just quoted a close connection between the University or the Research Institute, and the industrial concern. This is easier if the industry is more or less of a public character or if the technical problems to be investigated are concerned with activities natural to a Government or Municipality. Thus in Manchester, the Electricity Department and the Rivers or Sewage Purification Department of the Corporation maintained close touch with the University laboratories to their great mutual advantage. The beginnings of such co-operation are already evident in India as has been mentioned in a former article in *Current Science.*† Where possible, the teaching staff in a Research Institute or in the Technological Department of a University should be recruited from those who have combined both academic training and practical and responsible experience in the industrial world.

On the foregoing lines existing institutions in India may play their valuable part in helping forward the industrialisation which, it is generally agreed, is necessary if the future growth of the new Indian nation is not to be one-sided or limited.

It must, however, always be remembered that the urge to industrial development in the West derived its original impulse mainly from individual men of genius and vision. India also owes much to such men as Jamsetji Tata, Sir P. C. Ray and their associates. Soon it may be hoped that the facilities provided by the generosity of Laksmi Narayan and other wealthy benefactors will also bear fruit. The fulfilment of the great ideas present in the minds of such pioneers will require the loyal and keen enthusiasm of younger India and the support of widely diffused and intelligent public opinion.

GILBERT J. FOWLER.

† "Water Pollution Research," *Curr. Sci.*, January 1939, pp. 3–5.

Bombay Fisheries

REGULAR readers of this *Journal* are no doubt familiar with the establishment, a few years ago, of a small Fisheries Section of the Department of Industries in the Presidency of Bombay with the main object of augmenting the fish supply of the town of Bombay by the use of motor launches. Under the able guidance of Dr. S. B. Setna, the Fisheries Section has made rapid progress and the scope of its working has gradually been widened. The *Annual Report* of the Department of Industries, Fisheries Section, 1937–38, recently published, shows the many-sided activities of this young department. The number of motor launches now in use for fish trade is 8, 4 belonging to the Department and the others privately owned. The bulk of the catch transported by these launches is obtained from the Karwar and Chendia which are about 270 and 290 miles respectively away from Bombay. The great utility of the launches in the fish trade will be evident from the fact that "This fish would not have come to Bombay without the launches but would have gone to the fish curing yards thereby reducing a first class edible commodity to a third rate product lacking in food value. Fish either salted or converted into manure would have fetched about five or six thousand rupees whereas in the fresh state it realised in Bombay about Rs. 60,000. This is an immense gain to the fish trade".

In the Report attention is directed to the fishing season and the quantities of fish brought by launches, to the needs for modern fishing methods, to the lack of suitable fish landing sites and to the need for the establishment of a marine biological station and an aquarium for research in fishery problems. Progress is reported in the training of apprentices to handle and operate the launches and in the establishment of new ice factories.

In the account of the fish curing yards attention is directed to the number of the yards, to the kind of fish cured at the yards, and to other varied aspects of their management.

Several experimental measures adopted for the improvement of freshwater fisheries are enumerated, and the success or failure that attended these measures is clearly indicated. The rapid growth in the size of *Catla* and *Gourami* in the Bombay waters is very encouraging, as both the species are good for stocking tanks. The proposal to stock certain ponds with *Murrel* fry is, however, full of danger, as the fish is a well-known predaceous form, and is likely to do considerable damage to the indigenous fish-fauna, if any, of these ponds.

The Fisheries Section also rendered considerable help to the Angling Association in the stocking operations at Powai Lake, and acted as the bureau of fishery information for attending to enquiries on a variety of subjects from the general public, and the Provincial and State Governments.

S. L. HORA.

LETTERS TO THE EDITOR

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A Note on the Kinetic Theory Expression for the Viscosity of a Gas

By an elementary application of the kinetic theory, the expression for the viscosity of a gas works out to be $1/3\ nm\bar{c}\ \Lambda$ where n is the number of molecules per c.c., m is the mass of a molecule, $\bar{c}$ the mean velocity and Λ the mean free path. This expression is approximate and differs from the accurate expression proposed by Chapman[1] by a numerical factor. A modified elementary procedure is suggested herein, which leads to an expression practically identical with that of Chapman. In the elementary derivation of the formula for viscosity, it is assumed that the number of molecules crossing a unit area from a lower layer to an upper layer (and *vice versa*) in one second is equal to $1/6\ n\bar{c}$. If one replaces this approximate expression by the correct one, *viz.*, $n\sqrt{\frac{RT}{2\pi M}}$ (where R is the gas constant, T is the absolute temperature and M the molecular weight), the final expression for viscosity is found to become,

$$\frac{1}{\pi}\sqrt{\frac{MRT}{\pi}}\cdot\frac{1}{Nd^2} \text{ or } 0{\cdot}3185\sqrt{\frac{MRT}{\pi}}\cdot\frac{1}{Nd^2},$$

where N is the Avogadro number and d is the diameter of the molecule. The accurate expression for viscosity derived by Chapman is

$$\frac{5\times 1{\cdot}018}{16}\sqrt{\frac{MRT}{\pi}}\cdot\frac{1}{Nd^2} \text{ or } 0{\cdot}3175\sqrt{\frac{MRT}{\pi}}\cdot\frac{1}{Nd^2}.$$

A comparison of the two formulæ shows that by the modified procedure suggested herein, the expression obtained is practically identical with that got by Chapman, the difference between the two being barely 0·3%.

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March 1, 1939.

[1] *Phil. Trans.* (A), 1916, **216**, 337.

A Note on the Effect of Finite Breadth of the Hammer Striking a Pianoforte String

In a theoretical paper (*Bull. Cal. Math. Soc.*, 1937, 28, 187) it has been shown by me that the finite breadth of the hammer has an effect on the duration of contact. In the said paper duration of contact Φ is given by

$$\Phi = \pi\sqrt{\frac{M(a-b)}{T_1}},$$

where M stands for the mass of the hammer, a for the length of the shorter segment of the

string measured from the mid-point of the struck portion, b for half the length of the contact and T_1 for the tension of the string. As in none of the previous experiments by other workers could this result be checked, fresh experimental study of the problem has been made by the standard photography-method.[1] The camera slider with the paper facing upward moves horizontally along the groove of a massive wooden piece; a rigid pendulum, at the end of which glass projectors of lengths ranging from 0 to 3 cm. are clamped, serves as the hammer; a carbon arc lamp illuminates a fine slit vertically down; a long tuning fork of frequency 100, gives delicate wave traces of considerable length and amplitude thus admitting high precision in time-recording; the slider moves under the weight of a mass and as it moves its other end drags a ball through water contained in a long vertical chamber to ensure constancy of velocity; the photographic paper passes under the illumined slit only during the interval from the time the hammer begins to strike the string to the time the hammer leaves it,—such synchrony being achieved by means of an electromagnetic automatic operator. The final photographs are measured with the help of a long-focus travelling microscope. As M, in the present case of a rigid pendulum, is tedious to find, the durations of contact are expressed as ratios of Φ_0—the duration when $b = 0$.

$a = 10$ cm.

Length of contact	$\frac{\Phi}{\Phi_0}$ (Experimental)	$\frac{\Phi}{\Phi_0}$ (Theoretical)
1·0 cm.	0·985	0·974
2·0 ,,	0·970	0·948
3·0 ,,	0·957	0·922

There is an agreement in the order of magnitude but the experimental results show the decrease of Φ with the increase of b to be smaller than what the theory predicts. A detailed analysis together with the effect of curved hammer is in progress and will be published elsewhere in due course.

I take this opportunity to acknowledge my indebtedness to my father Mr. K. K. Bose, M.A., for facilities he has offered to me to carry out this work and also to Prof. K. C. Kar, D.Sc. for his keen interest in the same.

D. Basu.

Prativa Physical Laboratory,
Burdwan,
January 27, 1939.

[1] M. Ghose, *Ind. Jour. Phys.*, 1932, **7**, 365.

The Origin of the Tetraploid *Nicotiana* from Bathurst

In 1936 I received seeds from Dr. H. Wenholz, Australia, of Australian tobacco species. One package was labelled as "Wild tobacco, *Nicotiana* sp., Coll. R. G. May, Bathurst, N.S.W., immune or highly resistant to Blue mould, *Perenospora tabacina*". In the list of tobacco species sent kindly to me by Dr. Roy E. Clausen, California, *Nicotiana suaveolens* from Bathurst with doubled chromosome number ($n = 32$) was included. The plants that grew from the seeds sent to me by Dr. Wenholz originating from Bathurst were in many respects similar to *Nicotiana suaveolens* Lehm., and fit to the description given by Wheeler (1936) for the tetraploid *N. suaveolens* from Bathurst. They had 64 somatic and 32 gametic chromosomes, which means that they were tetraploids in respect to the Australian species having $n = 16$. A large number of Australian tobacco species as for example *N. suaveolens, N. maritima, N. velutina, N. excelsior,* etc., have 16 gametic and 32 somatic chromosomes.

Tetraploid *Nicotiana* species from Bathurst grew very vigorously. In favourable conditions it reached in height of about 180 cm., while *N. suaveolens* Lehm. in the same conditions reached a height of ca. 70–90 cm. The flowers of the tetraploid species were in many respects like those of *N. suaveolens,* the leaves were, however, much larger, somewhat broader and with uneven surface. The flowers of *N. suaveolens* have a very agreeable odour, while those of the tetraploid *Nicotiana* smell disagreeably like the flowers of *N. maritima,* though not as sharp as those of the latter species. The capsules of the tetraploid species are similar to

the capsules of the F_1-hybrids *Nicotiana maritima* × *N. suaveolens.*

In studying the meiosis of the tetraploid form I found usually 32 bivalents, though occasionally one quadrivalent or one trivalent and one univalent were also found. It was of importance from an evolutionary point of view to determine the mode of origin of this tetraploid form.

If we provisionally assume the number 16 for basic chromosome number for the *suaveolens—maritima—velutina* group of the Australian tobacco species, our tetraploid *Nicotiana* has then the genom formula *S S Sx Sx*. The fact that occasionally quadrivalents and trivalents were found during the meiosis of the tetraploid *Nicotiana* from Bathurst, suggested that certain chromosomes of *S* genom are homologous or have homologous segments with the chromosome of *Sx* genom. In order to determine, however, more definitely the degree of homology of *S* and *Sx* genoms, we crossed the tetraploid *Nicotiana* from Bathurst with the American tobacco *Nicotiana sanderœ* ($n = 9$, $2n = 18$). The hybrids between *N. sanderœ* and the Australian species are usually characterized with asyndetic meiosis. During the first meiosis in these hybrids usually 25 univalents were found, though one or two (rarely) bivalents sometimes also occur. The F_1-bivalents, the 9 univalents being *N. sandarœ* formed usually 16 bivalents and 9 univalents, which shows that *S* genom is homologous to *Sx* genom since the chromosomes of these two genoms conjugated (autosyndesis) forming 16 bivalents, the 9 univalents being *N. sanderœ* chromosomes.

I attempted further to investigate the degree of differentiation of genom *S* in respect to genom *Sx*. Autosyndesis in F_1—*Nicotiana* from Bathurst × *N. sanderœ* showed that *S* genom is closely related to *Sx*, but these observations were not sufficient to answer the question as to whether *Nicotiana* from Bathurst is an autotetraploid or whether it is an allotetraploid from very closely related forms, the chromosomes of which conjugate during the first meiosis in their F_1-hybrids. In studying the procedure of the first and second meiotic anaphases and telophases in F_1-hybrids between tetraploid *Nicotiana* and *N. sanderœ* I found, that in some cells, chromatin bridges were formed. The formation of chromatin bridges during the meiotic anaphases suggested that the chromosomes of *S* genom are structurally not identical in respect to the chromosomes of genom *Sx*, the structural differences being of the type of inversions. This statement, although being of importance from a cytogenetic point of view, it does not decide the question of the autopolyploid or allopolyploid origin of the tetraploid form since the structural changes that characterises *S* and *Sx* genoms might as well have taken place until or after the chromosome doubling. The morphological and the cytological behaviour of the tetraploid species from Bathurst, the Australian species of the group *Nicotiana suaveolens—maritima—velutina* and the species hybrids *N. maritima* × *N. suaveolens*, *Nicotiana* from Bathurst × *N. suaveolens* and *N. suaveolens* intraspecific hybrids, suggested that the tetraploid *Nicotiana* from Bathurst has originated by chromosome doubling in F_1—*N. maritima* × *N. suaveolens* hybrid or in a *N. maritima—N. suaveolens* segregate. It should be mentioned here that F_1-hybrids *N. maritima* ($n = 16$) × *N. suaveolens* ($n = 16$) have almost normal meiosis, forming usually 16 bivalents and are fully fertile. Morphological appearance of the F_1—*maritima* × *suaveolens* hybrids is, in many respects, similar to that of the tetraploid *Nicotiana* from Bathurst. Disagreeable odour of the flowers of *N. maritima* dominates in F_1-hybrids which accounts for the presence of the same character in the tetraploid species. The odour of *N. maritima* flowers is, however, much more disagreeable than that of the tetraploid *Nicotiana* from Bathurst and of the F_1-*maritima suaveolens* hybrids. *N. suaveolens* is resistant to most of the virus diseases from which our tobacco species in Moscow suffer. *N. maritima* is very susceptible, while the tetraploid *Nicotiana* and the F_1-hybrids *N. maritima* × *N. suaveolens* are less resistant than *N. suaveolens* and less susceptible than *N. maritima.* The flower

shape of the tetraploid *Nicotiana* is similar, though it is not identical with that of the flowers of the F_1-hybrids *N. maritima* × *suaveolens*. Such deviations, however, are to be expected for the following three reasons: (1) They can be due to crossing-over and further to segregations in the allopolyploid *N. maritima–suaveolens*, since allopolyploids originating from F_1-hybrids with allosyndetic meiosis always segregate (*cf.* Kostoff, 1938*a*). (2) Chromosome doubling in plants ultimately leads to a series of changes in all the plant organs including the flowers (*cf.* Kostoff, 1938*b*, *c*, *d*). (3) Accumulations of new hereditary changes in the newly originated tetraploid and eliminations of the less fitting forms by natural selection. I shall also mention here that the areas of distribution of *N. suaveolens* Lehm. and *N. maritima* Wheel. overlap each other in South Australia.

The hybrids between the tetraploid *Nicotiana* from Bathurst and *N. suaveolens* Lehm. are highly sterile, being "triploids" and set occasionally very few seeds. The morphological appearance of the tetraploid *Nicotiana* from Bathurst, its physiological characters and cytogenetic behaviour give us sufficient background to separate it into a *species nova* which has originated by chromosome duplication in a hybrid and shall call it *Nicotiana eastii*. It is cytogenetically more isolated from *N. suaveolens* and *N. maritima*, than the latter two species amongst each other because the species *N. suaveolens* and *N. maritima* cross easily and their hybrids are fully fertile, while *N. eastii* does not cross so readily with *N. maritima* and with *N. suaveolens* and its hybrids with these two species are highly sterile.

DONTCHO KOSTOFF.

Academy of Sciences, U.S.S.R.,
Moscow,
March 1, 1939.

Kostoff, D., (1938 *a*), *Journal of Genetics*, **37**, 129.
—, (1938 *b*), *Ibid.* **34**, 447.
—, (1938 *c*), *Current Science*, **7**, 108 and 270.
—, (1938 *d*), *Nature*, **142**, 1117.
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Embryological Evidence for the Relationships of the Lythraceæ and Related Families

HUTCHINSON (1926) in his recent classification of the Dicotyledons has made a great departure in the systematic position of the Lythraceæ and related families from that usually assigned to these in the older systems. Bentham and Hooker (1862–83), Engler and Gilg (1924), Bessey (1915) and Wettstein (1924) have all placed the families Lythraceæ, Sonneratiaceæ and Onagraceæ along with families like Myrtaceæ and Combretaceæ in the order Myrtales (or Myrtifloræ). Hutchinson completely disregards this generally accepted view, and places the former families quite apart from the latter in a separate order Lythrales. This order, including Lythraceæ, Crypteroniaceæ, Sonneratiaceæ, Punicaceæ, Oliniaceæ, Onagraceæ, Halorrhagaceæ and Callitrichaceæ, is derived by him from the Caryophyllales through the sub-family Sileneæ, while the Myrtales, including only the families Myrtaceæ, Lecythidaceæ, Melastomaceæ, Combretaceæ and Rhizophoraceæ, is supposed to represent the epigynous forms of the Theales and some Tiliales.

During the last five years the writer has been closely associated with several investigations on the embryology of both the Centrospermæ, which includes the order Caryophyllales of Hutchinson, and Lythraceæ and Sonneratiaceæ. The data obtained from these investigations appear to throw definite light on the supposed relation between the Caryophyllaceæ and the latter families.

The Caryophyllaceæ have certain characteristic embryological features. The mature pollen, as Schnarf (1931) says, is tri-nucleate. Its form, as known from *Arenaria*, *Silene* and *Dianthus*, is that of a pentagonal dodecahedron (Kerner and Oliver, 1895). There are as many germ pores as the faces of the grain. The ovule is always more or less campylotropous (Gibbs, 1907; Rocén, 1927; Woodcock, 1926 and 1928; Joshi, P. C., 1936). The micropyle is formed only by the inner integument. The nucellus is capped by several layers of cells

formed by periclinal divisions in the epidermis (Souèges, 1922).* The development of the embryo-sac corresponds to the *Normal*-type. The antipodals degenerate early (Schnarf, 1931), though in some other families of the Centrospermæ they persist up to the time of fertilisation or even afterwards (Joshi, 1936*b*), and may even multiply (Maheshwari, 1929; Bhargava, 1932; Kajale, 1937*b*). Diverticula commonly arise from the embryo-sac. After fertilisation the embryo-sac assumes an annular form. The embryo development corresponds to what has been designated as the *Caryophyllaceous*-type (Souèges, 1922). The embryo proper in this case develops from more than one cell of the filamentous proembryo and the basal cell formed by the first transverse division of the oospore never divides further. It becomes greatly enlarged and haustorial. The endosperm is present in the mature seed as a cap of cells over the radicle, and, as is well known, the mature embryo is annular and surrounds a central mealy perisperm (Rocén, 1927; Woodcock, 1926 and 1928).

The Lythraceæ (Joshi and Venkateswarlu, 1935*a*, 1935*b* and 1936) agrees with the Caryophyllaceæ in the development of the embryo-sac and in the early degeneration of the antipodals. In all other characters it is markedly different. The ellipsoidal-spherical pollen grains possess only three germ pores arranged in an equitorial manner. They are two-nucleate at the time of shedding. The generative nucleus divides into two male nuclei in the pollen-tube only just before fertilisation. The ovule shows absolutely no signs of campylotropy. It is generally anatropous. The micropyle is formed by both the integuments. The nucellus is not covered at its apex by any epidermal cap, but generally shows a hypostase below the chalazal end of the embryo-sac. There is no formation of any diverticula from the embryo-sac. The embryo development corresponds to the *Capsella*-type. The structure of the mature seed is also quite different. There is neither any perisperm nor endosperm. The embryo is quite straight.

The family Sonneratiaceæ agrees in most of its embryological characters with the Lythraceæ (Venkateswarlu, 1937), and the Onagraceæ, although it differs in the development of the embryo-sac, agrees in other respects with the Lythraceæ. It has certainly no characters common with any of the Caryophyllales. On the other hand, as Tischler (1917), Mauritzon (1934) and Joshi and Venkateswarlu (1936) have indicated, the *Oenothera*-type of embryo-sac can be derived from that of the Lythraceæ.

The above embryological studies thus indicate quite clearly that Lythraceæ and allied families are not closely related to the Caryophyllaceæ as suggested by Hutchinson (1926). For the present it would be better to keep them along with the other families of the Myrtales.

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Benares Hindu University,
January 20, 1939.

* Rocén disagrees with Souèges in this respect, but from what is known of other Centrospermæ (Joshi, 1936*a*; Joshi and Rao, 1936; Kajale, 1937*a* and 1938; and the literature cited in these papers) the writer thinks Souèges' observations to be quite correct.

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Aceto-Carmine Smear Technique for Cotton Cytology

SKOVSTED[1] refers to difficulties encountered by several authors, including himself, in obtaining good fixation and staining of the meiotic stages in cotton, by the paraffin embedding method; and advocates an improved technique to overcome the difficulties. The aceto-carmine smear technique, in spite of the ease and rapidity of the method, has not been so far widely applied in the study of cotton chromosomes except by Longley,[2] and Webber.[3,4] This method was tried at this Institute, and it was found that very excellently fixed and stained chromosomes in the pollen-mother cells of cotton could be obtained following the technique recommended by Longley and Webber with slight improvements. Figs. 1 and 2 are photomicrographs of cotton chromosomes fixed and stained by this method. The following description of the method for obtaining successful results is given in the hope of its usefulness, particularly, to cotton workers in India.

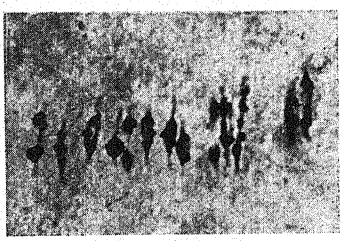

FIG. 1.

Photomicrograph of side view of metaphase I in the P.M.C. of *Gossypium arboreum* var. *neglectum* forma *bengalensis*. × 900

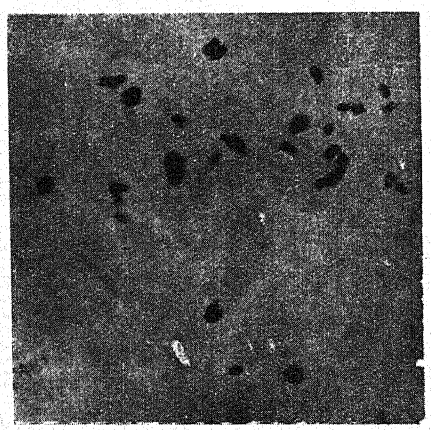

FIG. 2

Photomicrograph of diakinesis in an inter-specific sterile hybrid (F_1) in a cross between *G. hirsutum* and *G. herbaceum*. × 900

In the preparation of the aceto-carmine it was found that irrespective of the brand, only when a *fresh stock* of carmine powder was used that the staining was good. No iron need be added to the aceto-carmine if only the diakinesis and the later stages are to be studied. For the earlier stages, the addition of slight traces of iron helps to stain the thin threads more deeply. A rough idea of the length of the buds showing the meiotic stages is got by measuring the buds with a seed-measuring apparatus previous to examining their anthers and after stripping off the bracts and cutting off the pedicel at the point of insertion of the calyx. With slight variations, this length is more or less constant for any particular species of cotton. For the local cotton, *Gossypium arboreum* var. *neglectum* forma *bengalensis* that has been examined, this length is about 5·5 mm. For the F_1 hybrid referred to (Fig. 2) it is about 6·3 mm. The right stage of the bud to be fixed can be determined by crushing one of its anthers under aceto-carmine, when the pollen-mother cells with their thick glistening walls can be seen loosely scattered. Fresh pollen-mother cells of cotton do not stain properly, though a few cells show the chromosomes fairly well stained. After the removal of the perianth parts the buds are fixed for about 1–2 hours in Carnoy's fluid, and transferred to absolute alcohol in which they are allowed to remain for about a day. The buds are then transferred to 80% alcohol and stored for future examination. When it is desired to study the chromosomes, 3 or 4 anthers from a bud are crushed under aceto-carmine by pressing on the cover-glass. The cover-glass is then slightly raised on the sides to let in the aceto-carmine that has flown out when applying the pressure. The slide is allowed to remain as such for 20–30 minutes. Examining the slide after this under the microscope, will show that though the chromosomes are well stained, the

cytoplasm is densely stained too. The slide is then warmed by passing it over a bunsen or alcohol flame, a few seconds at a time. The heat destains the cytoplasm alone completely, and this should be carried to the right stage by examining the slide now and then under the microscope, and applying more heat if necessary. The aceto-carmine should not be allowed to boil. The edges of the cover-glass are then sealed with Canada balsam or melted paraffin. The slides thus prepared are fresh enough for study, for about a week.

In conclusion I wish to thank Mr. Ramiah, M.B.E., Geneticist and Botanist, for suggesting the problem and for his help in the preparation of the note.

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Indore,
February 3, 1939.

[1] Skovsted, A., *Ann. Bot.*, 1933, **47**, 227.
[2] Longley, A. E., *Journ. Agr. Res.*, 1933, **46**, 217.
[3] Webber, J. M., *Ibid.*, 1934, **49**, 223.
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Hairiness of the Midrib Edges in Sorghum

IN the sorghum plant whose stalks, leaves and leaf-sheaths form a good fodder, it can be said that there is practically an absence of hairiness in almost all the parts. The *Para-Sorghums* are however characterised by markedly villous nodes and leaves with stray long hairs on them. The *Eu-Sorghums* do not have this character and could be said in general to have smooth stems and leaves. Vestiges of hairiness are however met with. All sorghums have a felt of hairs on the upper side of the auricle, the triangular specialised junction, joining up the leaf-sheath and the leaf-blade. In addition to this, the commonest place at which hairs occur is the nodal band, the soft greenish tissue at the base of leaf-sheath and above the actual node. When hairs are present here, the lower sides of the felty auricular triangular areas are usually hairy. When the nodal band is hairy, it has been noted as a sure guide to the hairiness of the glumes (Ramanathan[1]). But this has not always been the case. It looks more a case of close linkage than the same gene operating in two different places. There are types with hairy nodes and glabrous glumes and *vice versa*. When the glume is hairy, the junctions of the primary and secondary panicle branches tend to be hairy also. The above are the common types of hairiness in sorghum, slender though the hairiness be.

In addition to these, special manifestations of hairiness are also met with. The occurrence and inheritance of one of these is described here.

In this type there occurs a row of hairs on either side of the midrib-groove towards the lower half of the leaf. The hairs are about 1 mm. long and they bend up one on the other towards the tip side. In addition to their presence on either side of the midrib-groove, they occur on the parallel veins in the blade area on either side of the midrib. On these veins they are confined to the very basal inch or two, and even here they appear less and less on the veins as they go towards the edges —so much so, this hairy midrib character is virtually hairiness on a zone in the neighbourhood of the ligular process (including the very base of the midrib) with a thrust of a double row of hairs on either side of the midrib for about half its length. This delicate character is best manifested on the flag and gets less pronounced in the lower leaves until at about the sixth leaf from the top it is difficult of detection. The two rows of midrib hairs being hyaline and adpressed are best noted in the juicy stalked plants, against the dull colour of the midrib of their leaves. They are not so readily spotted in the pithy stalked white midribbed leaves.

The wild rhizomiferous *Sorghum halepense* (Linn.) Pers. manifests this character to a certain degree. The cultivated non-grain sorghums *S. dochna* var. *irrungu* (Burkill) Snowden (the Irungu cholam of South India) and *S. Dochna* var. *technicum* (Koern.) Snowden (Broom corn) have a few types with a slight manifestation of this character. It is

only in the African kafirs (*S. caffrorum*, Beauv.) that this character is distinct and common.

Seeds of the variety, *Nhorongo Neupe*, were received through the courtesy of Kew from the Tanganyika territory. This variety belongs to *S. caffrorum*, Beauv. var. *Neesii* (Koern.) Snowden. A selection from this, *viz.*, A.S. 4637, showed this hairy midrib character very prominently. It is remarkable that along with this hairiness it was also noted to have a rhizomiferous tendency—a concurrent manifestation of two primitive characters. A number of selections were carried forward from A.S. 4637 and these included two, *viz.*, A.S. 5471 and A.S. 5472, which were suspected to be natural crosses as they had white midribs as against the family character of dull midrib in A.S. 4637. The two selections were, as expected, found to segregate as follows:—

Selection Number	Hairy midrib edges		Non-hairy midrib edges	
	White	Dull	White	Dull
A. S. 5471 ..	84	28	30	9
A. S. 5472 ..	74	25	24	10
TOTAL ..	158	53	54	19
Expected (9:3:3:1)	159·75	53·25	53·25	17·75

$X^2 = 0{\cdot}12$ $P > {\cdot}98$

It is obvious that the hairy midrib character is independent of the dull midrib character (juicy stalks). Owing to the ease of pursuit of this hairy condition on a dull midrib background, a third generation consisting of six hairy dull-midrib selections, was carried forward from A.S. 5472, one of the above F_2 families. The F_3 behaviour is given below.

It will be seen that the midrib edge hairy character, to which is given the genic symbol MD_H is a simple mono-genic dominant to the hairless condition (MD_h). The pairs of genes MD_H and MD_h are independent, in inheritance, of X and x, the pairs of genes responsible for

A.S. 5472—F_3 Selections

Selection Number	Character of Selection	Progeny Behaviour	
		Hairy midrib edges	Non-hairy midrib edges
A. S. 6341 ..	Non-hairy	..	Pure
A. S. 6342 ..	,,	..	Pure
A. S. 6338 ..	Hairy	Pure	..
A. S. 6339	,,	Pure	..
A. S. 6337 ..	,,	58	18
A. S. 6340 ..	,,	83	28
TOTAL ..		141	46
Expected (3 : 1) ..		140·25	46·75

$X^2 = 0{\cdot}014$ $P > {\cdot}90$

the manifestation of white and dull midribs in sorghum leaves (pithy and juicy stalks[2]).

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B. W. X. PONNAIYA.
Millets Breeding Station,
Coimbatore,
February 16, 1939.

[1] *Jour. Madras Agric. Students Union*, 1924, **12**, 1.
[2] *Madras Agric. Jour.*, 1936, **24**, 217.

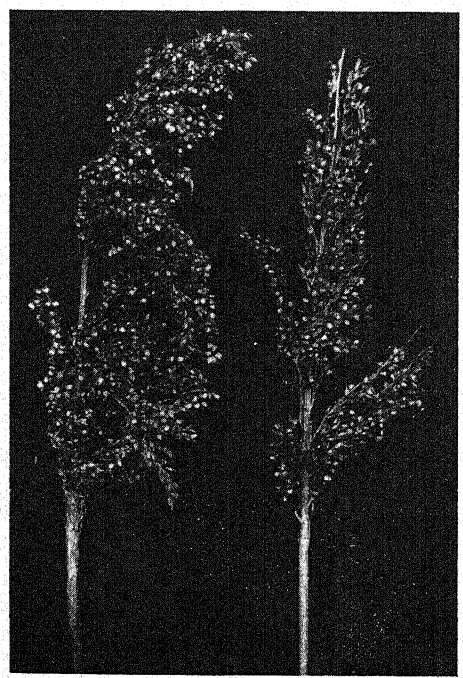
The Occurrence and Inheritance of Panicle-tip Sterility in Sorghum

THE sterility of the tips of the earheads of the rice plant has been noted. Earheads with this character have been called "spongy".[1] The heritability or otherwise of this character has not been worked.

In the cultivated sorghums which are pre-eminently single-stalked, sterility of the tips, even when it does occur, has hardly any chance of perpetuation and survival as this kind of sterility can be easily spotted and the defect gradually eliminated through vigilant selection. This defect is not evasive like the sterility brought about by empty anther sacs.[2]

Mtama is a variety of sorghum belonging to *Sorghum conspicuum* Snowden, seeds of which were received from the Tanganyika territory

through the courtesy of the Royal Botanic Gardens, Kew. This variety has a very long duration (140 days) and its earheads are very long and tapering, with long lateral branches in the lower whorls. When a single-plant selection, A.S. 4680, was raised and multiplied from this variety it was found that most of the plants had earheads in which the tips of panicle branches ended bare and blunt. Next year, when the earheads were examined close on emergence from the boot, it was found that a few spikelets at the tip of both the primary and secondary branches were devoid of contents, being mere whitish scales, which on the maturity of the panicle, dried up and snapped and dropped off along with bits of dried panicle branches attached to them. Among the population of such sterile tipped earheads there occurred a few plants which, while being like the mother type, differed in having panicle branches whose tips were normal. They were suspected to be natural crosses with sister types of *S. conspicuum* and one such natural cross was carried forward as A.S. 5478. It segregated giving 125 plants with normal panicles and 41 with panicles having sterile tips. Six selections were carried forward from this F_2 generation, four of them being normal and two with panicle branch tips sterile. The two recessive bred true to the character of tip sterility and out of the four normal panicles, two segregated. One of them, A.S. 6345, gave 65 normal and 21 tip sterile panicles, and the other, A.S. 6346, gave 85 normal and 30 tip sterile panicles. In families with sterility, the percentage of sterile tipped branches varied from 80 to 90 per head. The sterility is more pronounced in the top whorls of the panicles and in stray acute cases, tips of the central axis were laid bare (see illustration). An analysis of the normal and sterile panicles was done on five heads in each. It was noted that the primary and secondary branch lengths were an average of 14·5 and 4·0 cm. respectively in sterile tipped panicles, as against 17·5 and 6·5 cm. in the normal panicles. There was also a reduction in the total number of normal sessile spikelets, there being about 800 spikelets in the sterile as against over twice that number in normal panicles. Although the panicles were affected, the plants were otherwise normal in height, diameter of internode and in number and size of leaves.



Normal Tip-sterile

Sorghum Panicles

This Tip Sterile character has been met with, for the first time, in sorghum and it has been constant in manifestation in pure lines during the past three generations. A gene designated PA_{ts} is responsible for panicles with sterile tips. PA_{TS} produces normal panicles. PA_{TS} is a simple monogenic dominant to PA_{ts}.

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Coimbatore,
February 17, 1939.

[1] *Curr. Sci.*, 1936, **5**, 390.

[2] *Mem. Dep. Agric. India Bot. Ser.*, 1928, **14**, 199–245.

Grafting of Apple on *Eriobotrya Japonica* Stocks

CONSIDERABLE attention has been devoted to apple root-stock problem in many Fruit Research Stations in Europe, and especially, in the East Malling Research Station in England. Various root-stocks such as the 'Northern Spy', 'Paradise' and others have been used for grafting apples. There has been very little work done in India, to find out a root-stock for apples suitable for the prevailing conditions. It is usual in this country to import from Australia, apple plants grafted on Northern Spy root-stock. From experience in the Mysore State, these plants have been found to be susceptible to root disease (Rhizoctonia) and deteriorate after a few years of bearing.

In the search for a hardy root-stock, a few buddings of apple were made during May 1936

FIG. 1

on *Eriobotrya Japonica*, which, though successful, did not make much headway.

Eriobotrya Japonica (Loquat) is a medium-sized tree belonging to the order *Rosaceæ*, introduced in India from Japan. It grows well in gardens and is able to resist drought conditions owing to its vigorous root-system.

Cleft grafts made with the 'Jonathan' and 'Rome Beauty' as scions, began to put forth shoots in 18 to 20 days. The accompanying photograph was taken when the graft was six weeks old. Though these grafts have shown promising signs of growth, the compatibility between the stock and scion can be ascertained only during the next season's growth. The further development of these grafts will be reported later.

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Bangalore,
February 3, 1939.

A Terrestrial Species of Oedogonium

THIS is a preliminary note on a terrestrial species of *Oedogonium* collected by the author from Tanda and Fyzabad from August to October, 1938. So far no terrestrial species of Oedogonium has been described, and as compared with genus *Oedocladium*, some of whose species are terrestrial, *Oedogonium* is supposed to be a purely aquatic genus.

This species which appears in the form of green felt-like patches was found growing throughout the monsoon season in lawns, and compounds of houses. When the oospores ripen, the patches become orange-coloured. Ripe cospores are found in all the months, a few days of sunshine being enough to ripen the spores.

Vegetative cells are 6–8 μ broad and 26–70 μ long, are hyaline and unbranched with a rhizoidal function in the subterranean part, while the subaerial cells are 14–17 μ broad and 24–32 μ long. The alga is monoecious macrandrous. Oogonia are found singly, are globose, 30–42 μ in diameter and are operculate. Oospores are globose, do not fill the oogonia, have smooth chocolate-brown spore-wall and are 26–32 μ broad. Antheridia are 4–6 in number each containing one sperm, and are 11–14 μ broad and 6–10 μ long.

This is obviously a new species and has been named as *Oedogonium terrestris* sp. nov. The author is thankful to Dr. L. H. Tiffani of North Western University, Evanston, Illinois, U.S.A.,

for examining the material and communicating his views.

M. S. RANDHAWA.

Fyzabad,
January 14, 1939.

A Note on the Gametophyte of *Botrychium virginianum* var. *lanuginosum*, SW.

OUR knowledge of the prothalli, the germination and growth of spores of *Botrychium*, though scanty, is derived from the researches of Douglas Campbell[1] and Edward Jeffrey[2] who have described the American forms of the species *Botrychium virginianum*. The occurrence of this species of *B. virginianum* var. *lanuginosum* is reported from various places in India, but till now no account of its developmental history has been made known. The purpose of this note is to record a preliminary account of the gametophytes of the Indian variety *B. virginiaum* var. *lanuginosum*, which in certain respects differs from the published accounts.

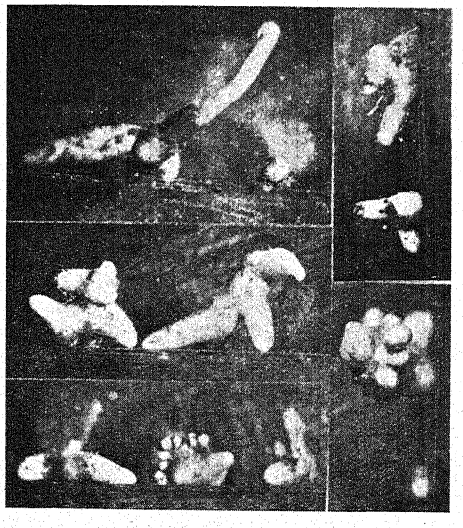

FIG. 1

Gametophytes of *Botrychium virginianum* var. *lanuginosum*, of different ages. Note the diversity of form and shape. At the left upper corner, the first leaf of a sporophyte with its circinate vernation can be seen. × 6.

In 1937, I obtained a large number of gametophytes of the variety *lanuginosum* from Kodaikanal and in the subsequent year, several younger stages were collected. The material which is under investigation has shown certain peculiarities well worth reporting at once. Campbell working on old prothalli has described them as flattened tubers, covered with root-hairs, with folded in margins and with reproductive organs buried on the superior surface. Regarding colouration, they were brown externally, though white in sections. Jeffrey working on fresh material has described the prothalli as flat and oval with root-hairs. According to him the growing point is at the narrow anterior end, the hinder part becoming thicker and wider. The antheridial ridge on the dorsal surface widens out in the older prothalli. The gametophytes of other species of *Botrychium* such as *B. lunaria*, *B. obliquum* and *B. simplex* have been described as being flat and dorsiventral bodies of varying shape, with an antheridial ridge on the superior surface. The prothalli of the Indian variety show essential differences. They are not flat

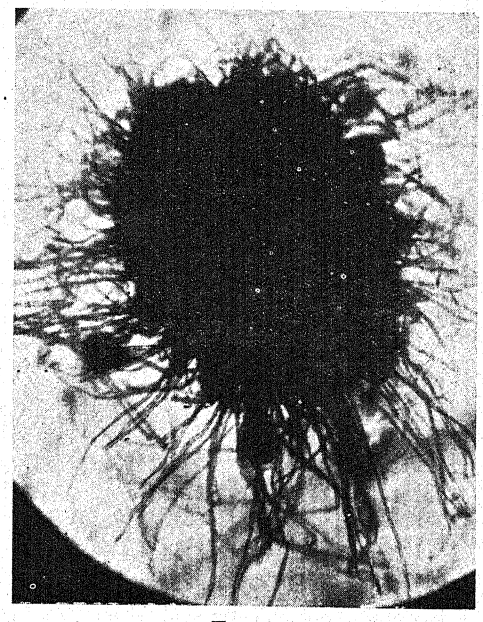

FIG. 2

Young prothallus with rhizoids. × 25.

dorsiventral bodies, but are spherical in shape, white in colour, having a number of irregular

indents on the otherwise smooth surface. They are generally smaller than the corresponding stages of the prothalli of the other species; and the subsequent growth of the former results in the assumption of a large variety of shapes shown in Fig. 2.

Endophytic fungus can be easily detected in bodies varying in size from 0·5 mm. to 0·2 mm. and if a young prothallus of this dimension is kept in a moist chamber, the fungus grows out in profusion. Separate cultures of the fungus have been prepared for studying the details of its life-history and association. The prothalli at the stage of the emergence of the endophytic fungus are devoid of rhizoids. The appearance of rhizoids synchronises with the change in colour of the prothalli from white to brown, and also marks the increase in their size (Fig. 1). When the colour changes into deep brown, the rhizoids are lost, fertilisation is completed, and on the young sporophyte developing, the prothalli increases in the size. Certain cases of prothalli almost entirely composed of sporophytic tissue have been noticed.

The results of further investigation will appear elsewhere.

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Bangalore,
March 11, 1939.

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—, *Ann. Bot.*, 1921, **35**, 141.
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Jeffrey, E. C., *Trans. Canadian Institute*, 1898, **5**.

Eugenia jambolana

The bark, the seeds and the fruit pericarp of this plant have some reputation as cures for diabetes, chronic diarrhœa and dysentery and as gargle for sore-throat. Though a certain amount of work has been done regarding the chemical composition of the seeds, rather conflicting reports have been made. The earlier workers reported the presence of a glucoside (Börsch)[1], quercitol and cinnamic acid (Pottiez)[2] and that an extract of the kernels prevented diastatic hydrolysis of starch (Stephenson)[3]. Later workers (Power and Callan[4], Hart and Heyl[2]) were of the opinion that the seeds contained no alkaloid, glucoside or enzyme. Further some of the samples that were examined do not seem to have been preserved in good condition. The results of our examination of a fresh sample of the seeds obtained locally agree with those of Hart and Heyl except in regard to the presence of free sulphur which we could not detect. Ellagic and gallic acids together with tannins are probably responsible for the medicinal value of the seeds. We have also obtained small quantities of a sweet smelling yellowish green oil and a colourless crystalline solid which has the properties of a wax. It melts at 81–83° and the unsaponifiable part of it has been identified as myrical alcohol.

The fleshy pericarp of the fruits has not been examined before. It is now found that the sweetness of this material is entirely due to the presence of reducing sugars and that there is a total absence of sucrose. The sourness and astringency seem to be due to the presence of gallic acid and tannin. A fairly high percentage (0·6% of the weight of the dried pericarp) of ammonium chloride could be isolated. The beautiful purple colour is partly due to the occurrence of an anthocyanin, which has been identified as cyanin. During our attempts to isolate this pigment, it was realised that a considerable portion of the colour is due to the presence of a second pigment, which is phenolic in nature and crystallises from dilute alcohol as snuff-coloured plates melting above 300° C.

Two colourless crystalline compounds have also been isolated from the pericarp, one melting at 149° C. and the other at 232° C. The first is easily soluble in alcohol and gives a bluish violet fluorescence when dissolved either in aqueous sodium carbonate or sodium hydroxide or in concentrated sulphuric acid. It seems to belong to the group of hydroxybenzopyrones. The second is far less soluble in alcohol and gives a pale green fluorescence

in concentrated sulphuric acid. Detailed reports about these compounds will soon be published.

N. V. Subba Rao.
T. R. Seshadri.
Department of Chemical Technology,
Andhra University, Waltair,
February 22, 1939.

[1] Börsch, *Pharm. Ztg.*, 1899, **44**, 574.
[2] Hart and Heyl, *J.A. C. S.*, 1916, p. 2805.
[3] Pottiez, *Ann. Pharm. Louvian*, 1899, **5**, 373, 490.
[4] Power and Callan, *Pharm. J.*, 1912, **34**, 414; 1913, **91**, 245; *J.C.S.*, Abst., 1912, ii, 480 : 1913, i, 1057
[5] Stephenson, *Pharm. J.P.*, 1892, 211.

Effect of Colchicine on Plant Cells

Recent discovery by Blakeslee and Avery[1] that dilute concentrations of colchicine can induce polyploidy in the plant cells is considered by many to be an important advance in plant genetics. This line of investigation is being pursued extensively not only with colchicine but with other chemicals also.[2,3] Experiments conducted in this laboratory to study the manner of action of the alkaloid colchicine have given results of interest. The method used was to study paraffin sections of root tip material, which had been treated with the drug. The growing root tips of *Pinus excelsa, Lathyrus odoratus* and *Allium cepa* were used, and the material was fixed soon after treatment, so that the dividing cells showed the effect of the drug. The fixative used was a chromic-osmic-acetic combination, which gave perfectly reliable results with these and other plant materials. The summary of results is as follows:—

1. The sprouted seeds of *Pinus excelsa* and *Pinus gerardiana* were so arranged that the radicle grew into a 1 in 1000 aqueous solution of colchicine. All the root tips survived and grew well, and the cells were invariably affected after 24 hours treatment. The typical effect of colchicine, irregular arrangement of chromosomes, failure of anaphase stage, and production of tetraploid cells were observed. A feature of interest was the striking elongation of all the dividing cells as a result of which the radicle lengthens during treatment. The microphotographs A and B are of cells from treated and untreated root tips of *Pinus gerardiana*. Both were taken at the same magnification (90 × 10 × F. for Bellows extension). Photograph A is from untreated root tips and two dividing cells are shown. B is taken from treated root tips and the arrangement of chromosomes in the single central cells shows the extreme elongation of the cell. From this it is to be inferred that colchicine affects not only the spindle mechanism, but also the whole cell.

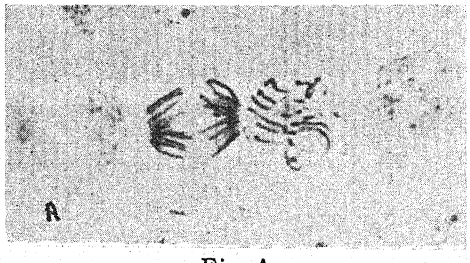


Fig. A
Dividing cells from untreated root tip of *Pinus*

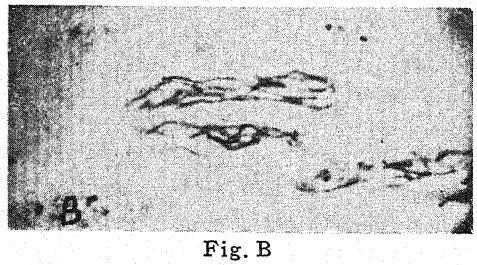


Fig. B
Dividing cells from treated root tip of *Pinus*

2. With *Allium*, bulbs were used, and practical difficulties had to be overcome before good growth could be obtained in aqueous colchicine. The 1 in 1000 solution gave results after 24 hours treatment. The characteristic results, namely, the irregular metaphase plate, and the failure of anaphase during division, were obtained. A feature of interest was, the chromosome structure was affected along with the chromosome behaviour. The spiral structure of telophase chromosomes twisting between sister chromatids during prophase, and the manner of chromatid separation at metaphase were more clear in treated material than in control root tips. Microphotograph C is that of an elongated nucleus probably in the

telophase stage. A few evidences of spiral structure in the chromosome is visible even in the photograph. From similar observations it is inferred that colchicine may prove a valuable tool in studying chromosome structure. Koshy's[4] and other recent publications show that there are important problems in chromosome behaviour which can be solved by accurate study of chromosome structure and in those problems the new tool will be of help.

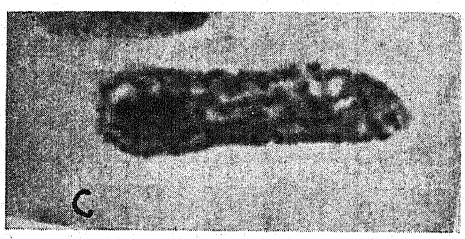


Fig. C

Nucleus from treated root tip of *Allium cepa*

3. Sprouted *Lathyrus* seeds were arranged to let the radicle grow into aqueous colchicine. Three strengths were used, 1 in 500, 1 in 1000, and 1 in 2000. At extreme dilution no cytological peculiarities were observed. At the other two dilutions results were obtained, which can be interpreted as a disintegration of dividing nuclei brought about by the drug. The reasons for such an interpretation are: (*a*) the cells concerned were not in the resting stage for they were totally unlike the normally fixed resting nuclei, (*b*) the appearance could not have been due to faulty technique, for root tips of *Rheo discolor* which were fixed and imbedded along with the treated material showed normal division, (*c*) there were deep staining spiral fragments within the nuclear membrane. The disintegrative action of colchicine on the nucleus suggests that in less harmful doses the drug may increase the mutation rate of *Lathyrus*. Such a possibility is being investigated.

Another feature of interest was noticed when respiration rate was studied in treated material. Sprouted seeds were soaked for 6 and 18 hours in 1 in 1000 aqueous solution of colchicine. The rate was 0·311 mgm. and 0·204 mgm. of CO_2 per hour per gram fresh weight, after 6 and 18 hours respectively. A control batch of seeds kept under similar conditions, gave the readings 0·103 and 0·293 after 6 and 18 hours interval respectively. Possibly the result may be due to an initial stimulation followed by a retardation. The possible connection between the naturally occurring alkaloid in a few dicotyledonous species and the response of those species to colchicine is being investigated.

S. Sampath.
B. N. Singh.
R. K. Bansal.
Institute of Agricultural Research,
Benares Hindu University,
November 12, 1938.

[1] Blakeslee and Avery, *Jour. Heredity*, 1937, **28**, 393.
[2] Dontcho Kostoff, *Curr. Sci.*, 1938, **7**, 108.
[3] Nebel and Ruttle, *Jour. Heredity*, 1938, **29**, 3.
[4] Koshy, *Jour. Roy. Micros. Soc.*, 1933, **53**, 299.

Koleroga Disease of Areca Nut

In North Kanara, Bombay Province, *Phytophthora arecæ* (Coleman) Pethybridge has not as yet been found occurring on any plant other than areca nut, nor have the oospores of the fungus been discovered under natural conditions. It is, therefore, difficult to explain the carry-over of the disease from one year to the next. However, in infected gardens one usually meets with diseased tree-tops, the infection of which takes place either from the affected bunch or through the leaf-sheaths which form the protective covering to the growing-point of the tree. Sometime ago it was suggested by one of us that the fungus, probably hibernates, as dormant mycelium in the dying tree-tops and, on the return of favourable conditions in late May or early June, it resumes vegetative activity and produces numerous sporangia which are disseminated by wind and initiate centres of infection in the same or neighbouring gardens from which the disease may be spread rapidly during the monsoon.

Beginning with October, isolations were made at intervals of one month by planting bits of diseased tops cut out aseptically on plates of Quaker-oats agar. The fungus was readily brought into pure culture, but later in the dry season it was found mixed with saprophytic

bacteria which invade infected tops. The pathogenicity of the isolates was tested on young areca nuts. It was also noticed that, as the dry season advanced, the number of successful isolations was somewhat less than in the months immediately following the wet season. The position, however, seems to change as the weather becomes cool and moist before the onset of the monsoon. The fungus now wakes to activity from its dormant state and resumes vegetative growth. Fig. 1 is a photograph of an infected tree-top taken on May 25, 1938, showing profuse vegetative growth when

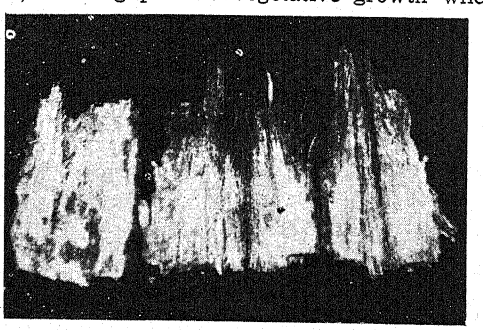


FIG. 1

the top was split open; young nuts were readily infected with material taken direct from the diseased top. However, under favourable conditions it is not uncommon to encounter dying tree-tops early in the dry season, in which cavities develop in the pith, usually containing a more or less dense growth of the mycelium of the fungus. Fig. 2 is a photograph of an infected top taken on February 4, 1939, showing vigorous growth of mycelium in the cavities of the pith.

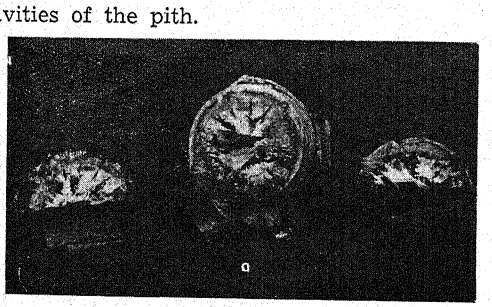


FIG. 2

In 1930, Narasimhan[1] reported the occurrence of heterothallic strains of *P. arecæ*. He showed, for example, that when single-spore cultures of the Areca and Santalum strains are grown together on Quaker-oats agar medium in Petri dishes, oospores are formed at the junction of the two mycelia. He further showed that the Areca strain possesses male characteristics as its mycelium bears antheridia and that the Santalum strain is female. He thus came to the conclusion that the absence of oospores in *P. arecæ* may be explained on the basis of the two sexual strains having been isolated on different host plants in nature.

Evidence has been obtained that heterothallic strains of *P. arecæ* may occur on areca nut in nature. Isolations of the fungus were made from diseased nuts in different localities in North Kanara and grown in different combinations on Quaker-oats agar medium in Petri dishes. The results of one of the experiments given in Table I show that the Tyagli and

TABLE I

Results obtained by pairing strains of P. arecæ *isolated from areca nut growing in different localities*

Strains paired	Oospore formation
Hipnalli × Vargheshwar	–
Hipnalli × Dambheshwar	–
Honavar × Dambheshwar	–
Nilekani × Harogar	–
Tyagli × Hipnalli	+
Tyagli × Vargheshwar	+
Tyagli × Dambheshwar	+
Tyagli × Honavar	+
Tyagli × Nilekani	+
Tyagli × Harogar	+
Analgar × Hipnalli	+
Analgar × Nilekani	+
Tyagli × Analgar	–

N.B.—The strains take their names after the villages in which they occur.

Analgar strains possess similar sexual potentiality and always produce oospores when

paired with any one of the other six strains. It appears that the sexual strains of the fungus have become definitely isolated in different areas, and this localisation of the two sex strains may explain the absence of oospore formation in nature. The case reported by Narasimhan[1] when Coleman once obtained oospores in areca nuts placed in Roux tubes and inoculated with a culture of *P. arecæ*, can now be satisfactorily explained by assuming that the nuts were carrying natural infection with one of the strains occurring on areca nut trees and that the culture used for inoculation must have been of the opposite sex.

B. N. Uppal.
M. K. Desai.

College of Agriculture,
Poona,
February 21, 1939.

[1] Narasimhan, M. J., *Phytopath.*, 1930, 20, 201–14.

A Re-description of *Lemdana marthae* Seurat, 1917

Lemdana marthæ, the only species of its genus was described by Seurat in 1917. This nematode has so far not been recorded from India. The figures given by Seurat do not show the specific characters. The description

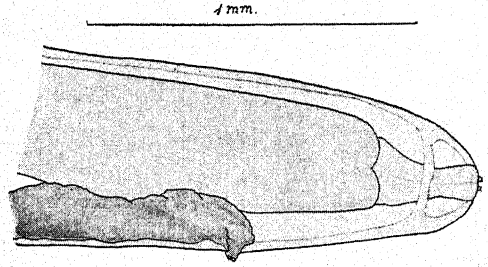


Fig. 1

Lemdana marthæ. Anterior end of female, lateral view showing the vulva

also is hazy, hence it is considered to redescribe this nematode.

Five females and two males of *Lemdana marthæ* were found under the epithelium in the neck region of a Spotted Babbler—*Pellorneum ruficeps*.

The females measure 32·9 mm. × 0·63 mm. to 45·3 mm. × 0·7 mm. The mouth is simple without lips. There is a pair of head-papillæ and a pair of amphids present. The nerve-ring is found just behind the anterior end.

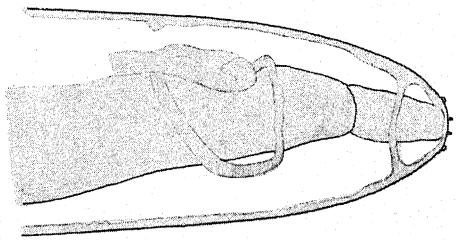


Fig. 2

Lemdana marthæ. Anterior end of male, dorsal view showing the head-papillæ and amphids

Cuticle is thick and smooth. The œsophagus is divided into two parts—an anterior short clear muscular portion measuring 0·36 mm., and a large dark glandular portion measuring

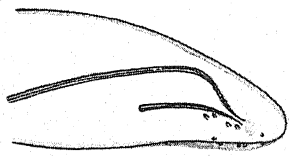


Fig. 3

Lemdana marthæ. Posterior end of male showing the position of papillæ

9·22 mm. in a female 32·9 mm. long. The vulva is very prominent and lies at a distance of 0·74 mm. from the anterior end. The anus lies near the conical posterior end and bears three subventral papillæ.

The males measure 18·9 mm. × 0·46 mm. Caudal alæ are absent. There are four pairs of pre-anal and a single pair of post-anal papillæ. The spicules are very unequal. The right spicule measures 0·32 mm. and the left spicule is 2·15 mm. in length.

The microfilaræ are unsheathed and found in the blood.

Host—*Pellorneum ruficeps*.

Location—Neck region.

Distribution—Aligarh, U.P., India.

M. B. Mirza.

Department of Zoology,
Muslim University, Aligarh, U.P.,
March 7, 1939.

[1] Sprehn, *Lehrbuch der Helminthology*, Berlin, 1932.
[2] York and Maplestone, *The Nematode Parasites of Vertebrates*, London, 1926.

Identity of Two Important Parasites hitherto considered as Distinct Species

THE Braconid parasite, *Microbracon lefroyi* Dudgeon and Gough, has been known to attack spotted bollworms of cotton (*Earias* spp.) and sometimes also the pink bollworm, *Platyedra gossypiella* Saund. Another Braconid, *Microbracon greeni* Ashmead, though known from much earlier time, has recently assumed importance as an important parasite of *Eublemma amabilis* Moore and *Holcocera pulverea* Meyr., which, being serious enemies of the lac insect, reduce the production of lac. The two parasites, *M. lefroyi* and *M. greeni* are very similar to each other in general appearance and morphology so much so that it is often impossible to separate them on structural grounds. Ramakrishna Ayyar (1928) also suspected them to be identical but at the time he did not go further than indicate their very close relationship.

The correct identification of these parasites, however, is a matter of great importance. They attack hosts which are economically very important and give considerable promise of being used in biological control work. It became, therefore, necessary to discover the specific distinctions, if any, between these two parasites. With this end in view, a large series of specimens of *M. lefroyi* available in the Pusa collection (identified by Brues) and also bred in the laboratory of the Imperial Entomologist and of *M. greeni* reared at the Lac Research Institute, Namkum, and made available through the courtesy of the Entomologist of that Institute, was examined.

It is a well-known fact that there are enormous variations within many of the species of the genus *Microbracon*. Perhaps the two most variable characters are size and colouration so much so that they often are practically useless by themselves in any specific determination. This is specially the case with the species *lefroyi* and *greeni*. Brues (1919), therefore, in his redescription of *lefroyi* recognised "melanic" and "light" forms: in the former black markings, though variable, included spot on front above base of antennæ, ocellar space, occiput, antennæ, stripe on each of the three lobes of mesonotum, scutellum, propodeum, irregular marks on pleuræ, abdominal segments 3-5 except narrow lateral border and sheaths of ovipositor. The 'light' forms were pale honey yellow with only the flagellum of antennæ, tips of mandibles, ocellar triangle, clouds on third and fourth abdominal segments and ovipositor black, piceous or brown. Ashmead's (1896) original description of *greeni* refers to the disc of metathorax, extreme apex of second abdominal segment and large dorsal blotches on third and fourth segments black. But breeding work on *lefroyi* under different conditions of temperature and humidity carried out by my colleague, Dr. Tashkir Ahmad has shown that these colour characters are not only most variable but that they can almost be produced at will by altering the temperature under which the parasites are reared. Thus under temperature of 16° C. only very dark forms emerge, while higher temperatures bring about greater lightness of body colouration. In size, specimens of both vary widely between 2 and 3·5 mm.

Differentiation between *lefroyi* and *greeni* on the so-called specific structural characters also breaks down when a long series of specimens of both is examined. Both have the antennæ 24-27 jointed, the ocelli in a triangle and the ocellar area dark, though this darkness is often, though not always, absent in *greeni*. The second abscissa of radius in the forewing of both varies from 1½ to over 3 times the first: in the figure of the wing of *lefroyi* given by Dudgeon and Gough (1913), it is easily 3 times and in Ashmead's description of *greeni* it is also said to be 3 times. The abdomen in both is roundish or broadly oval and the proportion of the lengths of the respective segments same. The length of ovipositor in both is again variable. In Ashmead's description it is 2/3 the length of abdomen but in a large number of specimens examined by me it is easily half the body length, a proportion which was originally given for the ovipositor of *lefroyi* by Dudgeon and Gough. It is clear that there is

not a single constant morphological character by which *lefroyi* and *greeni* can be distinguished, and they should, therefore, be regarded as identical.

Though morphologically indistinguishable the two parasites, however, do not, as a rule, oviposit on the same hosts. Attempts to induce *greeni* to oviposit on *Earias* spp., under different temperature conditions, have invariably failed at New Delhi. The larvæ were not even paralysed. The two parasites also seem to have some other biological differences, for example, those relating to the conditions for oviposition. It is evident, therefore, that *M. lefroyi* and *M. greeni* are two biological races of the same species. Since *greeni* was described earlier than *lefroyi*, the correct name of the parasites should be *Microbracon greeni* (Ashmead) race *lefroyi* and *M. greeni* (Ashmead) race *greeni*.

I wish to thank Dr. Hem Singh Pruthi, Imperial Entomologist, for kindly allowing me to make use of the observations of his other staff and for reading through the manuscript of this note.

K. B. LAL.

Imperial Agricultural Research Institute,
New Delhi,
March 7, 1939.

[1] Ashmead, Wm. H., *Proc. U.S. Nat. Mus.*, 1896, **18**, 633.
[2] Brues, C. T., *Rept. Proc. 3rd Ent. Meeting*, Pusa, 1920, **3**, 1026.
[3] Dudgeon, G. C., and Gough, L. H., *Agric. Jour, Egypt*, 1913, **3**, 108.
[4] Ramakrishna Ayyar, T. V., *Mem. Dept. Agric. India, Ent. Ser.*, 1928, **10**, 29.

Research Work on the Hilsa

THE review[1] of Dr. Hora's recent paper on Hilsa* by Mr. J. Travis Jenkins has, we fear, hardly done justice to the research on the same fish carried on in the province of Madras. To the reader not acquainted with the investigations, the review is likely to convey the impression that they are confined to the province of Bengal. The following extracts from the review, for instance, are open to challenge:—

(1) "Until the recent discoveries of Dr. Hora which are described in the paper under review, practically nothing definite was known of the spawning habits and grounds of the Hilsa, though there was naturally much guess-work."

(2) "In spite of investigations made by several scientists, no step forward was made until Dr. Hora discovered large numbers of very small Hilsa, etc."

(3) "Now that the first and most difficult step has been taken by Dr. Hora in elucidating the mystery of the spawning of the Hilsa, we await further discoveries in the near future, and in particular, the eggs and first larval stages."

Mr. H. C. Wilson succeeded in hatching Hilsa eggs as early as 1908 and 1909 and Dr. B. Sundara Raj succeeded in hatching out ten million fry at the Coleroon hatchery in 1916. The collection and hatching of Hilsa eggs continues as a routine at Madras.

Quite different is the impression one gets by a perusal of the paper by Dr. S. L. Hora; for this author has faithfully summarised the work relating to Hilsa done in this province. By omitting the share of work done by the Department of Fisheries, Madras, from the scope of his otherwise complete review, Mr. Jenkins has, we fear, run the risk of misleading the average reader unfamiliar with the work on this anodromous or estuarine fish.

D. W. DEVANESEN.

Marine Biological Station,
Krusadai Island,
Gulf of Mannar.
January 17, 1939.

[1] *Vide* pp. 251 and 252 of *Current Science*, No. 5, Nov. 1938.

* "A Preliminary Note on the Spawning Grounds and Bionomics of the so-called Indian Shad, *Hilsa ilisha* (Hamilton) in the River Ganges," by Sunder Lal Hora, *Records of the Indian Museum*, 1938, **40**, Pt. II, 147–58.

REVIEWS

Lectures on Quantum Mechanics, Vol. I. By M. R. Siddiqi, Professor of Mathematics, Osmania University. (Osmania University Publications), 1938. Rs. 6 or 8*s.* 6*d.* net.

This is the first Indian publication of a text-book on Quantum Mechanics, and can certainly take its place among the best of the elementary books written on the subject. The author intends to deal with the advanced portions in a second volume, and we hope that this will be published early so that the two volumes might go a long way in popularising the study of this most important subject in our Universities. We had had too much of Statics and Dynamics, Attractions and Potential, Spherical Astronomy, Theory of Elasticity, Celestial Mechanics, Classical Electricity and Magnetism and subjects of a similar nature in the curricula of special subjects for the Honours and Master's degree examinations of our Universities, and it is time that we taught something more modern in outlook, offering wider possibilities for investigation and research. The book under review written on a subject of this type by one who has made a thorough study of the subject, and is conversant with Indian standards will prove very useful for this purpose.

The book consists of eleven chapters of which the first four are of an introductory nature dealing with special relativity, classical mechanics and physical notions of atomic structure and reaction theory. The author has made a departure from the usual practice in presenting relativity theory before dealing with the general Hamiltonian theory of classical dynamics. This is certainly simpler since it makes it easier to introduce naturally the notions of the relativistic Lagrangian and Hamiltonian. In fact, the author has taken advantage of the notorious difficulty, not yet overcome, of the introduction of the methods of transformation theory into classical relativity. A welcome feature of the chapter on the structure of the atom is the mention of the discovery of the positron and neutron, and the great simplification introduced in nuclear physics by Heisenberg's conception of the structure of nucleii as made up of only protons and neutrons. The fifth chapter is devoted to Bohr's transitional theory, the sixth to Heisenberg's matrix mechanics, and the seventh and eighth to Schrödinger's wave mechanics. The perturbation theory which is most important in all applications of quantum mechanics is given in the ninth chapter from both the wave and matrix points of view. The tenth chapter is philosophical in outlook, and contains an excellent critique of the concepts of indeterminacy and causality. The last chapter contains Dirac's theory of the electron, and in view of the fact that there is really nothing inherently difficult in this theory, the author has wisely decided to include it in the first volume of the work.

We might notice some special features of the book. The development of matrix analysis, the explanation of the notions of eigen-values and eigen-functions, and the proof of the equivalence of the wave and matrix methods are all extremely well done. The essentials of the theory of the neutral helium atom are presented in a simple and lucid manner. The deduction of the uncertainty relation as a consequence of the quantum condition is presented at great length unlike many other elementary books.

The great difficulty in writing a book on quantum mechanics is the question of choice of material. The applications are so important and so numerous that in trying to present as many of these as possible, one has to sacrifice the logical development of the fundamental notions. Dr. Siddiqi has carefully kept this in mind when writing the book, and the result is an eminently readable, well reasoned out and nicely balanced text-book.

The printing and get-up are excellent, and the book is moderately priced.

B. S. Madhava Rao.

Grimsehl's Lehrbuch der Physik. Vol. II, Part I. The Electro-magnetic Field and Optics. Rewritten and enlarged by Professor Dr. R. Tomaschek, (B. G. Teubner, Berlin and Leipzig), 1938. Pp. 866. Price R.M. 26.

The book is divided into four sections: I. Static, Electric and Magnetic Fields. II. Direct Current Electricity. III. Periodically Varying Electro-magnetic Fields. IV. Optics. To electricity and magnetism 575 pages are devoted, and to light 262 pages. An appendix of useful physical and mathematical tables is included with the book.

This text is intended for students who have had a good introductory course in general physics and for the use of instructors in higher schools and colleges. The standard is hardly equal to that of the Indian University B.Sc. requirements though the scope is very much greater.

Since the value of a teacher is to be measured, in part at least, by his ability to present his subject as a living growing unified whole, related to the world in which we live, the alert and progressive teacher of physics will welcome such aids as Grimsehl's *Lehrbuch der Physik*. A very valuable feature of the book is the correlation between physical theory and practice, in modern society. This is an aspect of physics teaching in India which deserves attention.

The enormous number of topics discussed in the 837 pages of text necessitates great economy of words. The exposition, though brief, is clear. The 1,209 excellent diagrams and photographic illustrations greatly enhance the value of the work. Mathematics is used rather sparingly.

A considerable number of important recent technical developments are described, among these being the new high efficiency vapour-arc-fluorescence lamps, electron tube circuit breakers, magnetic and electric lenses for focussing electron beams and the ultra electron-microscope, the cyclotron, etc. The strong technical bias of the book will inspire the reader with a sense of the reality of physics and of its immediate value in every-day life. Such a book helps one to realize what science does, and what it might, contribute to human welfare, not only in material things but even more in the cultural realm.

Probably the chief value of Grimsehl's text in India will be in providing the teacher of college physics with inspiration and ideas for lecture demonstrations. Those who have to do with the framing of university physics courses, and compilers of physics text-books, will do well to carefully consider the material and treatment in this book.

Unfortunately, because of the language difficulty, the book under discussion is available to only a small number of those who need it. It is to be lamented that because of language barriers, much of the world's cultural wealth is accessible to limited groups of people only. How much better it would be if we could learn to co-operate in the matter of language and in every field of human activity rather than continue the strife to cultivate and maintain racial and national prejudices and thus perpetuate needless handicaps.

J. M. BENADE.

A Manual of Radioactivity. By Hevesy and Paneth. II Edition. (Oxford University Press, London), 1938. Pp. 306. Price 17*s*. 6*d*.

A few years ago 'Radioactivity' was a fairly well-defined subject; but it is becoming increasingly difficult to prescribe its boundaries, for the immense field of nuclear physics has grown out of it. 'The Child is the father of the Man' in more senses than one, and this precocious infant, Nuclear Physics, has lost no time in adopting its parent. The spontaneous disintegration of atoms is now looked upon as one nuclear phenomenon amongst many others, to be explained in terms of our general understanding of nuclear structure, and not as a mysterious anomaly in the scheme of Nature.

In this second edition of a well-known text-book of radioactivity the authors have thought fit, as far as possible, to keep within the old limits. This is a wise choice, for otherwise the whole character of the book would have been changed. But to keep entirely within the old limits would scarcely have been possible, still less desirable. In 1926, when the first English edition was published, the nucleus was unknown territory, though speculation was working on such experimental facts as were available. In that edition, the chapter on 'The Structure of the Atomic Nucleus' now reads like

a page from some ancient history, though it was orthodox science at the time. Such a remark as "We can state with certainty that in the uranium nucleus, for example, there must be at least 6 electrons, corresponding to the 6 β-raying daughter elements" now sounds very naive; but it is well, in our superior wisdom, not to forget that the orthodoxy of to-day may be equally naive to-morrow.

Nevertheless, the genuine progress that has been made, in the twelve years intervening between these two editions, is surely very remarkable. The nucleus may still be unknown territory, but it can be broken up by bombardment from without, and forced to yield some of its secrets. It is fitting that an account of this should now find a place in three compact but very useful chapters. Otherwise the chapter headings are generally similar to those of the first edition, though the contents of the chapters have been brought up to date, and modern developments have received due attention.

The general design of the book remains unchanged. It is intended primarily to be a book for the student, and the arrangement of material largely ignores the historical order of discovery. A short historical survey forms the last chapter. Also quite deliberately, no attempt is made to provide a bibliography, but at the end of the chapters a few references are given to other books and to representative original papers. Naturally, much detail is omitted, for an attempt to be exhaustive would again defeat the purpose of the authors in providing a text-book suitable for students. All who have used the book in its first edition are aware that within these chosen limits it forms an admirable survey of the field of radioactivity, and in the second edition the high standard has been well maintained. We must, therefore, welcome the new edition as a timely and valuable contribution to the literature of the subject.

Although the book is intended primarily for the student, there are few workers in radioactivity so omniscient that they will not learn something from it. One of the valuable features is the large number of tables, which in many cases, give numerical results so fully as to make the book a useful work of reference. Many numerical data are given on quite modern work, such as artificial radioactivity, which the average student may not readily find elsewhere, and which the research worker may be quite glad to find gathered together in convenient form. The graphs, diagrams, and other illustrations, are extremely clear.

Another useful feature is the careful detail in which information is gathered together on topics which are not always referred to in other works. The chapters dealing with the preparation and chemistry of the radioactive elements, and the chemical behaviour of substances present in extremely small amounts, are examples of this. A discussion is given of various effects produced by the rays from radioactive substances, including biological effects. There is also an important chapter on the connection with geology and the radioactive methods of determining the age of the rocks.

The translation is well done, though here and there a reader familiar with German will catch a reminiscence of the original. Errors of fact, or of printing, are extremely rare; the reviewer has noticed only one or two very minor points of this kind. It need hardly be said that the paper, printing and binding are all of the high standard which we expect from the Oxford University Press.

This book is, on all accounts, very suitable for those who wish to gain an insight into the domain of radioactivity, and is to be warmly commended.

H. J. TAYLOR.

Stream and Channel Flow. By E. E. Morgan. (Chapman & Hall, Ltd., London), 1938. Pp. 240. Price 25*s*.

This is essentially a book of Hydraulic Graphs and Tables for the everyday use of engineers. The author himself writes in the Preface that "Calculations relating to the uniform flow of water in open channels and streams being laborious, the author prepared for his own use a set of graphs and tables, by means of which velocity and discharge problems could be solved in a quick and simple manner. These have also been used by the River Branch of the Highways and Bridges Department of the Surrey County Council and their success

has encouraged the author to publish them for the assistance of others engaged on work of a similar nature."

The author has used Manning's formula

$$V = M R^{2/3} S^{1/2}$$

where M, the coefficient of roughness has been given a definite value or has been expressed as $1{\cdot}4858/n$ where n another form of the coefficient of roughness has the same values as in Ganguillet and Kutter's formula.

The author says that the selection of Manning's formula was the result of a very careful investigation by the author and "recent research on this subject" he says, "has confirmed rather than otherwise the choice of this formula for channel flow".

There is a chapter on "Recent Researches" dealing with the experiment of Nikurdse and Prandtl-von Karman formula for rough and smooth pipes. The author shows that if the substitution of the hydraulic mean depth in place of the diameter is correct then the author's use of Manning's formula for rectangular concrete closed culvert is confirmed by the Prandtl-von Karman formula for rough pipes.

So far the author is on sure grounds but when he turns to the application of Manning's formula to natural streams and canals he is forced to admit that "Although the indirect application of the von Karman-Prandtl formula for rough pipes to rivers, streams and canals appears to confirm the use of Manning's formula by the author, yet, in the case of natural streams at least, the direct application of the equation

$$v = 4\sqrt{2g}\left(\log \frac{R}{\epsilon} + 1{\cdot}17\right)\sqrt{RS},$$

is dependent upon entirely fictitious assumptions."

In spite of this fact and of the fact that "the choice of the appropriate value of n to suit the conditions of the channel is largely a matter of judgment" the author has found from his own experience that the application of Manning's formula to earthen channels and rivers gives a better agreement than any other existing formula. Of the existing formula for open flow he mentions those of Chezy, Kutter and Bazin. No mention is made of the fomulæ of Kennedy or Lacey though in India these are mostly used.

In the Tables themselves there is a departure from the usual practice. The author gives a table for $\sqrt{S}$ for different values of the slope and then splits up the expression for velocity and discharge so that

$$V = \left[\frac{1{\cdot}4858}{n} R^{2/3}\right] \cdot S^{1/2}$$

$$Q = \left[A \frac{1{\cdot}4858}{n} R^{2/3}\right] \cdot S^{1/2}$$

and denotes

$$\left[\frac{1{\cdot}4858}{n} R^{2/3}\right]$$ as the Velocity Multiplier and

$$\left[A \frac{1{\cdot}4858}{n} R^{2/3}\right]$$ as the Discharge Multiplier.

Tables are also supplied for these "Multipliers" for the three values of n.

$n = 0{\cdot}025$
$n = 0{\cdot}030$
$n = 0{\cdot}014$

N. K. B.

The Phase Rule and Phase Reactions—Theoretical and Practical. By Sydney T. Bowden. (Macmillan & Co., London), 1938. Pp. 302. Price 10*s.* net.

Phase rule, in comparison with other branches of physico-chemical knowledge, has attracted fewer workers and exponents. Neither the number of books on Phase rule nor the space usually allotted to its treatment in text-books is commensurate with the importance of the subject. The appearance of a new book on the subject, like the one by Dr. S. T. Bowden is, therefore, to be warmly welcomed.

The book "is intended to serve both as a theoretical and practical text-book and covers the requirements of the Higher School Certificate and the degree examination of the Universities". A perusal of the contents of the book convinces one that this is a very modest description of the scope of the book. Every branch of the subject has received adequate attention and every principle has been amply illustrated by numerous examples, special attention having been paid to the practical aspects. A special feature of the book is that 'a number of typical experiments are described in detail'. Every teacher of

Chemistry will endorse the view of the author: "The fact that a student has no time to perform a particular experiment need not preclude him from knowing how it is done". It is in fact these descriptions that have contributed to make this book specially useful to the student and the teacher. Typical questions have been included at the close of each chapter and this enhances the usefulness of the book.

Dr. Bowden has written his book in easy and beautiful style and most of the chapters and several sections are decked with choice and pithy quotations from poetical and scientific writings—a feature that Mellor made familiar. This book should find a high place in didactic chemical literature.

A. N. K.

Research and Statistical Methodology Books and Reviews. Edited by Oscar Krisen Buros. (Rutgers University Press), 1938. Pp. vi + 100. Price $1·25.

This publication is a reprint of the bibliography and book-review section of "The 1938 Mental Measurements Yearbook of the School of Education of Rutgers University", and contains a fairly exhaustive list of important monographs, books of tables and statistical methodology dealing with the modern developments in statistical technique as applied to a comprehensive list of subjects like biology, agronomy, education, psychology, actuarial mathematics, business, economics, engineering, forestry, sociology and vital statistics. The title of each monograph and book is followed by full bibliographic references, along with references of important reviews in the English language.

The publication of this volume supplies a long-felt want; and we believe that the author has, by undertaking the labour of examining critically hundreds of statistical journals and books, rendered a distinct service to research workers in statistics. The proposal to issue this publication every year deserves full support. The value of the book will be further enhanced if, space permitting, a list of important papers and memoirs of the year on various branches of statistics appearing in the leading statistical journals can also be included.

K. KISHEN.

Balance of Payment, 1937. (League of Nations, Geneva), 1938. Pp. 212. Price 6*s*.

This issue analyses the international payments of almost all the chief commercial countries of the world in recent years. To facilitate analysis and interpretation of statistics relating to international balance of payments, most of the statements for individual countries are compiled on the basis of standard forms. Comparable figures are given in the case of practically all the countries represented for goods, interest and dividends, other services, gold and long-terms and short-terms capital movements.

Most of the detailed statements in the case of individual countries are accompanied by a summary table of balances of payments, together with the totals of all inward and outward payments for the last few years. To facilitate international comparison, these balances have also been combined in a table where they are converted into United States gold dollars at the old parity.

An interesting chapter is devoted to a detailed analysis of recent trends in commercial transactions. It contains an exhaustive study of the changes in connection with current items in the trade of creditor and debtor countries, and international capital movements from one country to another. It will be seen that since 1931 the debtor countries have had a large active balance in the case of these items (*i.e.*, transactions in goods and services, *plus* newly-produced gold exported), aggregating for the period 1931–37 to some 5 milliards of dollars (at the old gold parity of the dollar), which has thus been available for reduction of their foreign debt. In addition, some debtor countries have employed funds derived from the sale of foreign holdings or gold reserves in banks for debt reduction. On the other hand, certain debtor countries, particularly those within the sterling block, have built up large foreign exchange reserves in London and New York. It will also be seen that creditor countries in recent years have drawn upon their foreign assets to a greater extent than has been commonly supposed.

A special section is devoted to the speculative movements of capital between creditor countries. The inflow of capital to the United States is analysed by means of diagrams showing, *e.g.*, the relation between the amount of foreign purchases of securities

on the one hand and share prices on the New York Stock Exchange on the other, and again between the inflow of foreign bank funds on the one hand and the total amounts lent to brokers and Stock Exchange operators on the other. The effects of tourist traffic, emigrants' remittances, the capital market and gold movements are also analysed.

The above brief particulars will show the interest attaching to the 1937 issue of *Balances of Payments* for the purposes of economists and business men.

TARINIPROSAD GHOSE.

International Trade Statistics, 1937. (League of Nations, Geneva), 1938. Pp. 450. Price 12*s.* 6*d.*

This volume published by the Economic Intelligence Service of the League of Nations contains very useful information of foreign trade statistics of 66 countries (instead of 65 as in former editions) for the years 1935–37. Statistics of imports and exports of goods per year and per month, the imports and exports per country and the imports and exports per principal articles, the imports and exports of bullion and specie, all these have been presented in tabular forms in a very lucid manner.

One marked feature of the 1937 edition of the *International Trade Statistics* is the grouping of imports and exports according to the international classification drawn up by the League of Nations Committee of Statistical Experts. The advantage of this new classification is that it enables international comparisons to be made on a scientific basis, not only for raw materials but also for various types of finished products.

This is a most useful volume and contains all but about 5 p.c. of the entire foreign trade statistics of the world.

TARINIPROSAD GHOSE.

Chronic Diseases of the Abdomen—A Diagnostic System. By C. Jennings Marshall. (Chapman & Hall, Ltd., London), 1938. Pp. 247. Price 25*sh.* net.

This is a book which must commend itself to all those who have to deal with conditions in the abdomen, both acute and chronic and as such it is equally interesting to the Surgeon, Gynæcologist and the Physician. It is of special value to the student who is preparing for higher examinations, as a great deal of information is available, both clinical and theoretical, in the different diagnosis of an abdominal case. The reading is somewhat terse but the tabular statements and the cross references give ample opportunities of understanding the subject to the student.

The illustrations are of great value and the radiographs are typical and clear.

The volume consists of 2 parts, the first dealing with the casting of the 'diagnostic net' and the investigations that could be carried out in any case where the main features are fixed on a particular system; the second part deals with abdominal pain, dealt with region by region, with the important conditions which may give rise to it in a classified manner. Lastly, the series of sections dealing with special symptoms are particularly valuable for reference.

Some of the special features of the book are:—

(1) The author's method of casting the diagnostic net;

(2) Evaluation of the laboratory tests and radiography which are indispensable in many cases and in others of great help; but wherever they are employed merely as a short-cut to avoid thinking, they are a menace;

(3) The importance of differentiating organic from functional diseases in the abdomen;

(4) The importance of intestinal neurosis with special reference to the type of the patient;

(5) The author's condemnation of the abdominal belt as a support for cases of visceroptosis;

(6) The importance of upper abdominal pain in cardiac diseases which may even amount to abdominal angina;

(7) An exhaustive study of Dyspepsia in all its aspects;

(8) The pitfalls and limitations in the diagnosis of right iliac fossa pain, which may be avoided by a proper study of the diagnosis of appendicitis;

(9) The extremely interesting and instructive manner in which Backache is treated from its various aspects, well tabulated and well illustrated by a valuable sketch;

(10) The exhaustive way in which the last few sections are dealt with such as

Hæmatemesis, Ascitis, variations and appetite, loss of weight, jaundice, vomiting and pyrexia, abdominal diseases.

The book is well worth reading both by the Specialist and the post-graduate.

A. L. M.

Field Determination of Rocks. By E. H. Davison, B.Sc., F.G.S. (Chapman & Hall, Ltd., London), 1938. Pp. 87 + viii. Price 7*s.* 6*d.* net.

In writing this book the author has evidently kept in view the needs of the field geologist and the prospector to whom a simple method of classification of rocks in the field without any intensive study requiring an elaborate equipment is of utmost importance. With this end, after a few hints on suitable equipment for field-work, the author gives a descriptive list of all the important rock-forming minerals, primary and secondary, which the field geologist is likely to meet with in his rock studies and which he has to recognise for purposes of his classification. Indicating the main forms in which the several types of igneous rocks occur in the field and the structures which they individually show, the author describes, in some detail, the essential characters of the different types and their mode of origin and classification. It is well known that no single system of classification of igneous rocks has been found to be thoroughly satisfactory. The author, however, for his purpose adopts the classification based on readily recognisable characters, such as mode of occurrence, structure, and mineral composition. Such classification may not by itself be sufficiently accurate from an academic point of view, and those who desire to go further and try to identify the several types and sub-types are well advised to supplement their studies with microscopic and chemical investigations in the laboratory. The author gives also, in the succeeding two chapters, the main characters of the sedimentary and metamorphic rocks.

The book is illustrated with 4 text-figures, and 10 plates showing well chosen structures of different rock types. It should prove highly useful to the field geologist and the prospector and should form a useful companion volume to *Field Tests for Minerals* published by the same author.

B. Rama Rao.

An Introduction to Botany. By J. H. Priestley and L. I. Scott. (Longmans, Green & Co., London), 1938. Pp. 615. Price 17*s.* 6*d.* net.

An Introduction to Botany, written by Professor J. H. Priestley and his colleague after several years of experience both in teaching and in research, is expected to contain many novel features in the treatment and presentation of the subject-matter with which it deals and as one goes through the different chapters of the book one feels that this expectation is more than fulfilled. There are many points of interest which strike one as original and new as the book is perused, but there are some features which are very important and mark a departure from several similar books published before.

The student is initiated, by gradual steps, to the study of form and structure of plants. He is first made to study plants as they appear to his naked eye. He is then made to see and study features which he cannot see with unaided eye, by the use of a lens, and finally with the help of a compound microscope. Thus his power of observation is gradually trained so that he is soon able to differentiate the anatomical peculiarities of different parts of the plant.

Another important feature of the book is that the structures and functions of the different parts of the plant are not dealt with separately but both are so blended together that the functions of a tissue or an organ is always associated with its histological features in the mind of the student. Thus the study of the external and internal morphological characters of a plant does not become a study of meaningless terms only to be crammed up for passing a test but it becomes a study of a living organism. The student is able to see and understand the plant as a whole, as one living unit, however complex, made up of parts which are interdependent and interrelated.

Though the book is meant for the use of First Year students, all the recent advances in plant sciences like the discovery of auxines and of the structure of cellulose and starch, are briefly summarised in a concise and intelligible form. The book can, therefore, be read with advantage by students taking degree courses in Botany and by laymen, who wish to know something about plant life which sustains them on this globe,

The book is well written in a simple and unambiguous language and is well illustrated. It tells, in brief, everything that is worth knowing about plant life in general and about flowering plants in particular.

R. H. DASTUR.

The Physiology of Plants. By William Seifriz. (John Wiley & Sons, Inc., New York; Chapman & Hall, London), 1938. Pp. 315. 17*sh.* 6*d.* nett.

The book is written for the use of the college student who has a background in general Botany, Physics and Chemistry. An encyclopædic assemblage of facts is not attempted as any such attempt will restrict its utility to the research worker. The book consists of 26 chapters extending over 302 pages. A few bibliographical references are given at the end of each chapter for purposes of collateral reading.

In the first chapter which is the introduction, the aim, scope and historical background of plant physiology are discussed. The various types of mechanisms and the forces involved in the 'Ascent of water' are thoroughly and concisely discussed in Chapter VII. The recent experiments of Dr. Philip R. White, in which he was able to measure directly the pressures developed in roots grown in culture and the light they throw on Root Pressure as one of the forces involved in the ascent of sap, are included in the chapter. The author has also presented in a simple and clear manner all the more recent outstanding researches such as vernalization, hydroponics, tissue culture, hormones, etc. Thus in Chapter XIX a succinct and exhaustive summary of the rapidly increasing work on Hormones and Growth Regulators is given. The recent success obtained in making isolated root-tissue to grow as an autonomous unit, and the new method of crop production in liquid culture media are described in Chapter XXI. The author has maintained throughout the book a lucid and fluent style.

The book would, undoubtedly, enable the college student to acquire a good grasp of the principles of plant physiology. Its use in colleges is therefore to be recommended.

R. SANKARAN.

Protozoa - Sporozoa. By B. L. Bhatia. *Fauna of British India Series.* (London, August 1938.)

The first volume on Protozoa dealing with Ciliophora in the *Fauna of British India Series* by Principal B. L. Bhatia, published in 1936, was reviewed in this Journal in October 1936 (Vol. V, p. 218). The present volume deals with the Sporozoa and completes the Protozoa. This group includes numerous organisms which are parasitic on hosts belonging to a number of phyla of the Animal Kingdom. Several of them are responsible for producing various diseases in man and domestic animals, and are consequently of great importance for medical and veterinary workers. Numerous others, while causing damage, in various degrees, to various tissues of the hosts, both vertebrates and invertebrates, are not dangerous to the hosts to any serious extent. The author has carried out detailed work for elucidating the correct zoological position and nomenclature of the pathogenic organisms, and as there is a certain amount of difference of opinion in regard to these very difficult questions, he has stated in detail "the argument or the authorities" on which he has relied for his conclusions.

As in the first volume, he has followed the most approved and up-to-date system of classification, and in the Identification Tables of Families he has included all the families, although several of them are at present unknown from India. For the Indian limits he has included the species known from India proper, Burma and Ceylon. In all 320 species are described in the volume and these, as the author rightly remarks, only form a very small fraction of the total known from other parts of the world. In the Introduction he deals with the position of Sporozoa in the Animal Kingdom, their general organisation and structure, phylogeny and classification, and includes a study of the group in India dealt separately under various orders, a short account of their distribution followed by two detailed lists of the parasites and their hosts and *vice versa* of the hosts and their parasites, and finally a short chapter on the technique of studying these interesting types.

How rapid is the progress of work on these organisms is apparent from the fact that since the major part of the work was set up, an addendum dealing with 13 additional

species had to be printed to complete the information.

The descriptions of various species are very detailed, and, in most cases, are illustrated by drawings of all genera and, if possible, of typical species. In addition, two coloured plates at the end of the volume add to the value of the work. A very detailed bibliography of almost 100 pages, arranged under various orders, is included at the end of the publication.

This volume on the Sporozoa should further stimulate work on this very important group of Protozoa, and both the author and the editor are to be congratulated on a very valuable addition to this valuable series on the Fauna of India. B. P.

Scoliodon (The Shark of the Indian Seas). By E. M. Thillayampalam. *The Indian Zoological Memoirs on Indian Animal Types*, II. Second Edition. (Lucknow Publishing House, Lucknow), December 1938. Pp. xiv + 126, 94 text-figs. Price Rs. 2–8.

Over 10 years ago, when this excellent Memoir was first published, it was rightly praised in scientific journals for the great deal of original work and wealth of general information contained in it. In the revised and enlarged edition, now published, Dr. Thillayampalam seems to have spared no pains to bring the work up-to-date by carefully pruning the existing material, by incorporating the results of latest investigations on Elasmobranchs, and by a rearrangement of the matter and its division into definite chapters. The thought and care thus devoted has rendered the treatment of this difficult subject much more lucid and comprehensive.

In the revised edition Professor Grace White's classification of Elasmobranchs replaces the older and more familiar classification of Garman, but fortunately the family position of *Scoliodon* remains unchanged. Of particular interest is the inclusion of a summary of the very valuable results of the investigations of Professor J. Gray on the locomotion of fishes. The nomenclature of blood-vessels has also been revised in the light of Dr. C. H. O'Donoghue's work. Additional information on such subjects as the physiology of blood-vascular system adds to the utility of the Memoir.

By limiting the bibliography to a few important references to publications within the easy reach of university students and by increasing the number of text-figures the usefulness of the Memoir has been greatly enhanced.

If any general criticisms are to be made, they are that the introductory chapter should have been entitled "Introduction and Classification", since this section deals mainly with the classification of fishes, particularly of Elasmobranchs, and with the distinguishing characters, and includes a key to the Indian species and history of the genus *Scoliodon*. In using 'Ventral median fin' instead of the popular term 'anal fin' some better argument should have been given than merely saying that "this name is not appropriate".

The revised and greatly improved edition of the Memoir on *Scoliodon* will not only be of use to Indian students in their laboratory work, but should also be invaluable to research workers all over the world interested in comparative studies of the various Elasmorbranch types. The reviewer will be lacking in his duty if he failed to congratulate Dr. Thillayampalam and the Editor, Professor K. N. Bahl, for this excellent production in a series of extremely valuable memoirs. S. L. HORA.

La Probabilite dans les differentes branches de la Science. By G. Castelnuovo. (Actualités Scientifiques et Industrielles No. 563. Hermann & Cie., Paris), 1937. Pp. 61. Price 12*fr.*

In this brochure Prof. Castelnuovo gives a general account of the meaning of probability and its applications to Statistics on one hand, and to Theoretical Physics on the other. In the first chapter the two kinds of probability—*a priori* and *a posteriori*—are introduced and explained. The Gaussian error law is discussed in the second chapter. The third and the fourth are devoted to the applications to statistics and theoretical physics respectively. The exposition is throughout in that clear and direct style so characteristic of Prof. Castelnuovo's writings and is enlivened by judicious and opportune historical references. The book may be heartily recommended to all who wish to obtain a bird's-eye-view of this increasingly important subject. V. R. T.

Stellar Dynamics*

THE recent publication of the book with this title by Prof. Smart can well be considered as a landmark in the development of this very important branch of Astronomy. Books written on a rapidly growing subject can be placed generally in two classes, those of a pioneering character, and those of a consolidating nature. Two remarkable books of former type on the two important subjects of Astrophysics and Stellar Dynamics have been written by Eddington, and are well known to workers in Astronomy. These books written early in the history of the development of the subject were in no small measure responsible for its further rapid progress, and for this very reason have become rather out of date as *text-books*. This is specially true of Stellar Dynamics since Eddington's book *Stellar Movements* was written just a decade after the birth of the subject itself, and the last quarter of a century has brought great and important additions to our knowledge of the subject. In so far as Astrophysics is considered, the want of text-books of a consolidating type has been met by the books of Rosseland and Unsöld. For Stellar Dynamics, the gap is now admirably filled by the book under review.

One finds some nearly three hundred references, in the footnotes, to papers published in several journals by the foremost workers in the field. This vast amount of material is suitably condensed and in many cases improved upon so as to suit the logical presentation of the subject. The author has achieved striking success in presenting, for the first time, a systematic account of Stellar Dynamics, and there is no doubt that this book will be extremely helpful in encouraging further research in many directions.

The book could be roughly sub-divided into three parts, *viz.*, Stellar Kinematics, Stellar Statistics and Stellar Dynamics, with an introduction devoted to the essential preliminary notions of Astronomy. The book is complete by itself, and does not presuppose any preliminary knowledge on the part of the reader except, perhaps, an acquaintance with a text-book on Astronomy like the excellent one by the author himself.

The Introduction, though short, is quite comprehensive, and contains all the necessary preliminaries. A general description of the galactic-system is followed by the explanations of the fundamental notions of modern Astronomy like spectral type, stellar magnitudes apparent and absolute, parallaxes, proper motions, radial velocities, masses, solar motion and galactic latitude, stellar evolution and the time-scale. It is quite appropriate, as an emphasis on the importance of the subject, that the author should include in the introduction itself a treatment of statistical notions like the correction of observed frequency curves, and mean values.

The next four chapters deal with the kinematical part, and exhaustive investigations are given of the theory of two star-streams, Schwazschild's Ellipsoidal theory and the solar motion. The mathematical treatment is greatly simplified by prefacing the discussion with a chapter on a single star drift, and the work in this chapter on the mean stellar speeds, T, R, W, and the formula for the drift curve by a Fourier series greatly facilitate the presentation of the two-star stream theory. In discussing this last theory special attention is given to technical details relating to the analysis of observational material. Probably the chapter on the Ellipsoidal Theory is the most beautiful in the book, while that on the solar motion is the most complete. Particular mention might be made of the general treatment of proper motions on the Ellipsoidal Theory, and the illustration of the analysis from a particular region of the sky, as also the determination by Smart and Green of the solar apex, and solar motion.

The statistical part consists of two special investigations followed by a chapter on general theorems of stellar statistics. The particular characteristics of stars, *viz.*, statistical parallaxes, and the space distributions of stars are first discussed by making suitable assumptions regarding the law governing the distributions of these characteristics. The important work of the author on the treatment of the density law of space

* *Stellar Dynamics*. by W. M. Smart, M.A., D.Sc., Regius Professor of Astronomy in the University of Glasgow. (Cambridge University Press), 1938. Pp. 1–429. Price 30*s*.

distribution on the ellipsoidal hypothesis is presented here in full detail. General theorems on stellar statistics are brought together in the eighth chapter, which explains the important work in this field done by Schwarzschild, Kapetyn, Eddington, Van Rhign and others.

The fundamental work of Jeans and Eddington on Stellar Dynamics is dealt with in the tenth chapter. The fundamental principles of the subject, the fundamental equations in several systems of co-ordinates, the theorems of Jeans and Eddington, the cases of spherical and cylindrical symmetry, the hydro-dynamical equations, the recent work of Shiveshwarkar, and the deduction of the possibility of star-streaming are some of the topics in a chapter which is rich in theoretical investigations and suggestions for further work.

The culminating portion of the book is, of course, the topic of galactic rotation. This is treated from the observational standpoint in the eleventh chapter whereas the last chapter deals with the theoretical aspects of galactic dynamics. This last chapter is undoubtedly the most important, and contains all the recent work on the galactic system. The relation between galactic rotation and star-streaming, and the derivation of the ellipsoidal distribution of stellar velocities are beautiful examples of the application of the general theorems of Stellar Dynamics to galactic rotation. The proof of the asymmetry of stellar motions by pure dynamical theory can well be considered as one of the triumphs of Stellar Dynamics. The limitations of the theory are also brought out in the investigation of the differential effects for radial velocities and proper motions, and the direction of star-streaming as consequences of the rotation of the galaxy about the galactic centre. The book concludes with an account of Oort's work on the density of dark matter in the neighbourhood of the Sun—a typical example of what modern Stellar Dynamics has been able to achieve.

A very useful appendix of astronomical constants is to be found at the end of the book, where it is very gratifying to find the Oort's constants A and B in company with aristocratic constants like the constant of gravitation, and the velocity of light!

Dr. Smart has written an extremely well-balanced book without omitting any relevant important work or without going off at peculiar radial speeds in particular directions. We might say with a zero "factor of exaggeration" that this book will at once become the standard work on the subject and remain so for a long time to come.

B. S. MADHAVA RAO.

Theosophy and Science Shake Hands*

IN the *Current Science* for August 1938, I had noticed the first volume of the series entitled "Where Theosophy and Science Meet" issued under the general editorship of D. D. Kanga, in which the ground, scientific and theosophical from "Macrocosm to Microcosm" had been surveyed, and the second volume under notice sketches, as it were, the progress from "Atom to Man". The volume opens with a contribution on "Matter and the Atom" by G. Monod-Herzen who points out that neither theosophy nor science "is yet complete", but both reveal the factor of progress, "an infinite succession of ignorances". The claim is advanced that "Theosophical observers revealed the existence of isotopes before the physicists did so" (p. 26). The second article is contributed by D. D. Kanga in which an attempt is made to show "where and how far Theosophy and Chemistry meet" (p. 29). After explaining the "septenary system" on which the Universe, according to Theosophy, is based, the author examines what Chemistry has to say, summing up the epoch-making discoveries of modern science". 49 sub-planes constitute the physical universe and man. Of these, scientific activity and research are restricted to just *three*. "It is only there that Theosophy and Science can meet" (p. 56). Then follows an article on "Physics" (Light, Sound, etc.), by R. D. Kanga. The author points out or claims that the modern "physicists have unconsciously entered into the region of metaphysics" .....(p. 86). The next contribution on "Relativity" is by Shyama Charan, as also the succeeding one on "Modern Mathematical Thought" in which the strange

* *Where Theosophy and Science Meet.*—Part II. Edited by D. D. Kanga. (Published by the Adyar Theosophical Library), 1938. Pp. 169. Price Re. 1-14-0.

equation is sought to be demonstrated that *one is equivalent to two* (p. 115). Then follows the contribution on "Evolutionary Biology" by Margaret A. Anderson, at the conclusion of which reference is made to the "next great race ..... destined to mount from the present ..... to the cosmic or intuitional level of consciousness" (p. 143). The concluding article on "From Mineral to Man" is by Corona G. Trew, who explains that "Mineral, plant and animal, three kingdoms are needed before self-consciousness is born" ..... (p. 157).

As I have indicated at some length, the arguments in my previous review on the basis of which I believe there is no need, practical or speculative, for any meeting between Theosophy and Science or Sciences, I do not propose to refer to them here, but, I would emphatically repeat the truth that any artificial meeting or *rapprochement* between Theosophy and Science must end in complete effacement or distortion of the distinctive individuality of both. My conviction is strengthened by a perusal of the second voulme under notice. The contributors sum up or bring together the results of the different sciences and argue that most, if not all, these results are found anticipated in the writings of Madame Blavatsky, especially in the *Secret Doctrine*, from which statements and *obiter dicta* are quoted.

I desire to make only one comment. The advantages of sciences and scientific investigation in the shape of Radio, Air-navigation *et hoc* have been placed within the reach of all on a scale of commercial distribution. When, however, I am told that there are still 46 sub-planes to be investigated, I am entitled to demand that I be let into the secret of these *planes* as legitimately as an inquirer would demand, say, light on the mechanism of the locomotive. Laboratory verification and commercial distribution would be the crux. In that crux-land, Theosophy and Science *emphatically do not meet.*

With great respect, I would like to make a present of the following to Sir C. V. Raman and other scientists. The writer on "Relativity" remarks quite sincerely, rather pathetically, I should suppose—"We do not know what is the nature of Light. We do not know what is the nature of Gravitation. We do not know what is the nature of Space-Time". I would like to put every sentence in italics. Whether the scientists know anything about Light or not, I do know that the *Advaitic dictum*, "Brahma-Satyam-Jaganmithya - jeevo - Brahmaiva-na-aparah" has nothing whatever to do with *Relativity* as understood and interpreted by Einstein and challenged by Sir Suleiman, I believe.

Nor am I convinced about the theoretical soundness or invulnerability of the so-called "Occult method", or practical application thereof making any standing or substantial contribution to the solution of any of the problems confronting modern mankind. There may be a "Scientific League of Nations" which Ritchie Calder wants, but, seeing the fate that has overtaken the League of Nations, similar leagues, even of scientists, must be deemed suspect. I also note that D. D. Kanga wants a Chair in Occultism in all the principal Universities of the world. In matters of advanced research, the Madras University always takes the initiative. I can only hope before the third volume is on the Editor's table at the *Current Science* Office, the Madras University would have established a Chair of Occultism, and appointed a proper Professor. Be that as it may, I detect a small typographical error in the text of *Brihadaranyaka* on page 94.

R. NAGARAJA SARMA.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.

(*University Librarian, Madras*)

Regaud, Stephen Peter (1774–1839)

STEPHEN PETER RIGAUD, a British astronomer, was born at Richmond in Surrey, August 12, 1774. His father was observer to the King at Kew, which is believed to have influenced the tastes and predilections of his son. He was educated at Richmond and Oxford and became M.A. in 1799. He was appointed reader in experimental philosophy and Savilian professor of geometry in 1810. He succeeded his father in 1814 as observer to the King at Kew and became Radcliffe observer in 1827. These posts he held till his death.

Rigaud made nineteen valuable contributions to the *Transactions* of the Royal Astronomical Society and to other periodicals. He was responsible for the addition of a new transit circle to the Radcliffe Observatory. He succeeded in persuading William IV to erect a monument to Bradley at Kew.

Rigaud is perhaps best remembered for his contributions to the history of mathematics and astronomy. In 1831 he published the *Miscellaneous works and correspondence of Dr. Bradley*. To this he added a supplement in 1833 which incorporated the astronomical papers of Harriott. He also published in 1838 a *Historical essay on the first publication of Newton's Principia*, in which he explained how Newton might have been led to give an erroneous value to the radius of earth. He also made extensive preparation for a life of Halley and a new edition of the works of Pappus. The first volume of his *Correspondence of scientific men of the seventeenth century* was printed just before his death, while the second volume came out posthumously in 1841.

He was elected Fellow of the Royal Society May 30, 1805 and was its Vice-President in 1837–38. Rigaud died in London March 16, 1839.

Colburn, Zerah (1804–1839)

ZERAH COLBURN, an American mathematical prodigy, was born in Cobot September 1, 1804. His father was a poor man with a large family of nine children. Zerah showed remarkable powers of calculation before he was six and his poor father tried to liquidate his poverty by exhibiting his son.

Having met with success in America he set out in 1812 to England where his prodigious son was admired by royalty and nobility. But Paris gave him a cold reception and the father lost heavily by his travel through France.

During 1816–19, Zerah was sent to the Westminster School under the patronage of the Earl of Bristol. But on the suspicion that the Earl was diverting some funds due to him, the father quarrelled with him and, plagued by poverty, induced his son to redeem their fortunes by a career on the stage. Failing there, he became a school master and ultimately returned to America in 1824, after his father's death. Even there he had only a chequered career, first being a minister till 1835 and then a teacher for the remaining four years of his life.

In 1833 Zerah published his autobiography entitled *A memoir of Zerah Colburn written by himself*. His arithmetical ability is said to have remained with him throughout his life. Leaving his widow and six children behind, he died of tuberculosis March 2, 1839.

Binnie, Alexander Richardson (1893–1917)

ALEXANDER RICHARDSON BINNIE, a British engineer of the Indian Engineering Service, was born in London March 26, 1839. Having received his general education privately and his engineering education from Bateman, he took up an appointment in 1862 in connection with the construction of new railways in Mid-Wales.

In 1867 he came to Nagpur as executive engineer. During his period of service he carried out the works for the supply of that city with water from Ambajheria, about four miles distant. He also made discoveries of coal in the Chanda District. This led to the construction of a railway and the opening up of the coalfields.

Having served as the Chief Engineer for water works to the City of Bradford from 1875 to 1890, Binnie became Chief Engineer to the London County Council. This position he occupied for nearly twelve years when he constructed the Blackwell and Greenwich tunnels under the river Thames, constructed the Barking Road Bridge and commenced the Vauxhall Bridge. He also reported on the reconstruction of the London drainage and widened the Strand, Aldwych and Kingsway.

After retirement from the London County Council, Binnie commenced private practice with his son as a partner. The works that engaged his attention during this period were the Arterial Drainage of Ireland, the water-supply of Malta, the water-supply and drainage of Petrograd and the water-supply of Ottawa.

His paper on the *Nagpur water works* is of interest even now. His paper *On mean and average rainfall and the fluctuations to which it is subject* won for him a Telford and a George Stephenson Medal.

On the completion of the Blackwell Tunnel he was Knighted and in 1905 he was elected President of the Institution of Civil Engineers.

Binnie died at Beer May 18, 1917.

Tata, Jamsetji Naserwanji (1839–1904)

JAMSETJI NASERWANJI TATA, an Indian pioneer and patron of scientific research, was born at Naosari in Gujerat March 3, 1839. After studying in the Elphinstone College, Bombay, for three years, Tata entered his father's business and set sail to China in 1859 to further their export business.

Turning his attention to the cotton industry in Bombay, Tata first studied the conditions of

Lancashire mills and later established his own Empress Mills in Nagpur January 1, 1877. In 1896 he published a monograph on *Growth of Egyptian cotton in India* and sought to acclimatize Egyptian cotton in India. The inauguration (1893) of the Japanese Steam Navigation Co., the promotion of the Tata Iron and Steel Co. (1907), and the far-sighted inspiration of the Bombay hydro-electric schemes have been sufficient causes to accord Tata a foremost place among the pioneers of Indian industry.

While quietly doing many deeds of kindness, Tata never indulged in promiscuous charities which are but a temporary relief to the inefficient. Convinced of the deficiencies of higher education in India, he inaugurated in 1892 a scheme by which a few promising young Indians were sent to England to qualify for higher administrative and technical services. He was proud of his scholars, "Our young men," said he, "have proved that they can not only hold their own against the best rivals in Europe on the latter's ground, but can beat them hollow".

Tata realised that the course of study in the Indian Universities stifled originality and initiative. His remedial plan took shape as an offer to Government of India on September 28, 1898 of property in Bombay estimated to yield an annual income of Rs. 1,25,000. He also deputed a promising young man, Burjorji Padshah, to European seats of learining to find out the most productive use for the endowment. "What advances a nation or a community is not so much to prop up its weakest and most helpless members as to lift up the best and most gifted so as to make them of the greatest service to the country," so said Tata and started with Padshah's provisional scheme to work out his remedial plan. Its final form took shape as the Indian Institute of Science, Bangalore, "an institution devoted to post-graduate study and research, particularly in science, and conducted with a view to the application of science to Indian arts and industries, with a constitution resembling that of a University.

Tata refused to accept the proposal that the Institution should be named the Tata University, though his contribution towards its establishment amounted to 30 lakhs of rupees. The Institute began its work July 24, 1911.

Tata died at Nauheim, a German watering place May 19, 1904.

ASTRONOMICAL NOTES

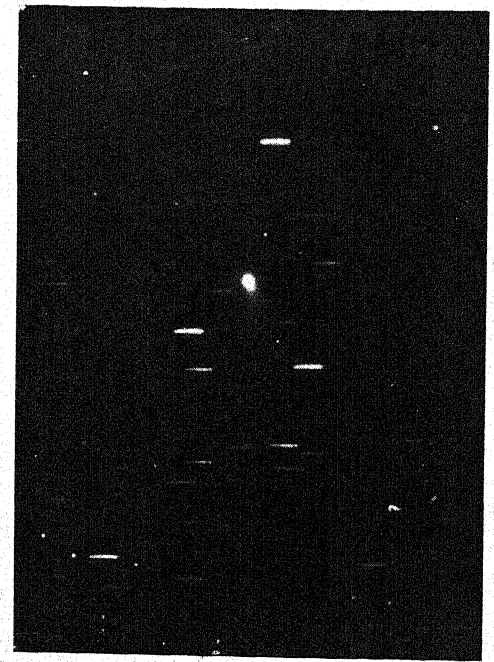
Solar Eclipse.—An annular eclipse of the Sun will occur on April 19, but the phenomenon will not be visible in India. The path of the annular eclipse lies towards the extreme north —in the Arctic Ocean and the north-west part of North America.

Planets during April 1939.—Mercury is in inferior conjunction with the Sun on April 3; and during the latter part of the month it can be seen low down near the western horizon at about sunset. Venus will continue to be visible as a bright morning star for nearly two hours before sunrise; it is slowly moving towards the Sun and becoming fainter. Mars, rising about midnight, will be well placed for observation during the late hours of the night; its brightness is increasing, the stellar magnitude being $-0{\cdot}2$ at the end of the month.

Jupiter, although not in a favourable position for observation, can be seen as a morning star rising about a couple of hours before the Sun; on April 22, there will be a close conjunction of the planet with Venus which is worth observing. Saturn passes conjunction with the Sun on April 11 and at the end of the month, will be just visible near the eastern horizon.

A lunar occultation of interest, that can be observed in India is that of the first magnitude star Spica (α Virginis) which will occur on the night of April 4–5, about an hour after midnight.

Comet Cosik-Peltier (1939 *a*).—As indicated by the ephemeris, the comet became somewhat brighter. On February 8, the magnitude was 5·8, just bright enough to be seen with the unaided eye. The object was diffuse with a sharp nucleus, and had a conspicuous tail over a degree in length, which was well visible with even small instruments. At the time of closest approach to the earth, the distance appears to have been about 50 million miles. The comet has been moving rapidly in a south-easterly direction from the constellation Cetus to Eridanus.



Comet Cosik-Peltier (1939 *a*)

Taken at the Nizamiah Observatory, Hyderabad.—Feb. 14, 1939. Exposure: One hour, ten minutes.

The Photograph was taken with a 4½ inch astro camera attached to the astrographic equatorial. The images of stars in the region are shown as short trails due to the motion of the comet relative to the stars during the time the exposure was made. The tail appears to be about a degree in length.

T. P. B.

Agricultural Research in India

THE Imperial Council of Agricultural Research has, since its inception in 1926, identified itself to an increasing extent with the course of agricultural research all over India. The latest Report of the Council, for 1937–38, gives a good indication of the rapid growth that has taken place in the Council's research activities during the last 5 or 6 years. The Council has at present on its hands over a hundred schemes and is maintaining a staff of over 300 research officers. The total expenditure on these schemes came to over Rs. 17 lakhs, during the year under review, out of which Rs. 4·25 lakhs were earmarked for sugar research and were spent, partly for the maintenance of the Imperial Institute of Sugar Technology at Cawnpore and partly to finance various schemes relating to the improvement of the sugar industry in different parts of the country. The other major activities, which consume over a lakh of rupees per head, are marketing schemes (2·56 lakhs), veterinary and nutrition research (2 lakhs), fruit research (1·11 lakhs), cold storage (1 lakh) and rice research (1 lakh). About 78 thousand rupees were spent on locust research, 71 thousands on wheat and barley, 47 thousands on oil seeds, including a sum of 15 thousands given to the Harcourt Butler Technological Institute, Cawnpore, 46 thousands on potato, 14 thousands on tobacco and about 20 thousands for studies on soils and manures. Among other items, may be mentioned a sum of Rs. 25,900 spent to maintain the botanical sub-section at Pusa, a sum of Rs. 22,600 given for the Agricultural Meteorological Section at Poona, and 58 thousands given as grants to various scientific bodies outside India.

The great prominence till now given by the Council to researches connected with the sugar industry has no doubt been amply justified by the remarkable results achieved in developing the industry during the last 5 or 6 years, but the sugar boom is now practically ended and there is no reason why the further development of the industry should not be left to a special Sugar Committee, similar to the existing Cotton, Jute, Coffee, Tea and Rubber Committees. Sugarcane is probably the last of our agricultural booms, and it is unlikely that we shall witness any further examples of sudden large-scale development in a crop, except probably to a limited extent in oil-seeds, fruits and rice.

The most pressing problem, however, which would demand the Council's serious attention in the near future would consist in devising measures for increasing the production-capacity per acre of the present area under cultivation, for extending the area if possible and for setting up an organisation which could secure the best return to the cultivator for the produce of his land. The production value per acre in India is, as is well known, notoriously low when compared to other countries such as Italy, Spain, Holland, etc. It could be increased only by better and judicious manuring of the crop, by greatly extending the present irrigation facilities and by popularising the use of improved strains. It may be said that most of this work properly falls within the ambit of the provincial governments, but there are several problems involved in the programme, which require to be studied on an all-India basis and the Imperial Council of Agricultural Research could best act as the co-ordinating agency which could tackle such problems, avoid overlapping and supplement local resources.

For securing the best utilization of the present area under cultivation and for reclaiming the areas at present designated as "cultivable wastes", it is necessary to have a preliminary All-India Soil Survey, on a properly predetermined plan. This could best be carried out under the auspices of an all-India body such as the Council, with the co-operation of provincial governments.

In this connection, the recent remarks of Sir John Russell in reviewing the work of the Imperial Council of Agricultural Research, may also be kept in mind, especially his plea for bridging the gulf between the laboratory and the field and for placing the question of increased productiveness as the central problem before the country. Among the other problems awaiting more systematic attention in the near future, Sir John has mentioned those relating to the improvement of the quality of food-stuffs, development of the dairy industry and encouragement of fruit and vegetable cultivation —all directed towards securing an improvement in the diet of the Indian people.

Sir John has also recommended a more systematic study of irrigation problems and of water relations between soil and crops, of questions relating to erosion and maintenance of soil fertility—all of which could best be dealt with by an All-India Soil Conservation Committee.

At present, the resources of the Imperial Agricultural Research Institute are not fully utilized for tackling the several fundamental and applied problems, which the Council has to solve. Though some problems of a purely academic type could best be given over to Universities and other scientific institutions scattered over the country, in order to create a general interest in them in agricultural research, there are numerous other problems closely interleaved with practical agricultural conditions, *e.g.*, those relating to soils, manures, plant breeding, plant diseases, quality of crops, etc., which could best be tackled at a central Agricultural Institute such as the one at Delhi.

Another direction in which the Council could usefully extend its activities, lies in efforts at securing a better price to the cultivator for the produce of his land. This may be done by a more efficient system of marketing—beginnings of which have been already made by the Council—and also by finding other industrial outlets for agricultural produce. This latter aspect is already engaging the serious attention of economists and agricultural experts in West-

ern countries. Though India could usefully consume a much higher proportion of food materials than she produces at present, still in view of the depressed market for cash crops such as cotton, rubber, coffee, tea and sugar-cane, and the early possibility of an all-round increase in the production capacity of our land per acre due to better manuring, increased irrigation facilities, etc., there is bound to be an increasing excess of agricultural production over consumption and the problem of how best to utilize the excess must be faced.

Agriculture is the chief industry of India and there is no reason why more efforts should not be made to find industrial outlets for our agricultural products. Space does not permit a discussion of the methods adopted in America, Germany and elsewhere in order to tackle this problem. Already the Imperial Council of Agricultural Research have got a few schemes of an Agri-industrial nature such as the malting of cholam, but further scope in this direction is immense. C. N. A.

Indian Forest Mycology with Special Reference to Forest Pathology*

WORK done in India on forest tree diseases and the peculiar problems which they present have received little publicity and Dr. K. D. Bagchee, who is investigating them at Dehra Dun, dealt, in his Presidential Address to the Botanical Section, at considerable length, with what has been so far accomplished. In forest tree disease investigations, the root and stem rotting fungi, the canker pathogens, the nursery diseases and the rots of timber call for attention but none, perhaps, gives more anxiety to a forest mycologist than the rusts which cause a great deal of damage to young plantations, especially of conifers.

In the case of root and stem rotting fungi, the discovery of the primary pathogens responsible for the rots is of great importance. Bagchee finds that the rots, in more cases than one, are the result of the combined action of several fungi and bacteria, as in the case of the *gauj* disease of *sal* in the U.P. Terai. In the root-rot disease of *shisham*, he has definitely discovered that the primary organism of the disease is a species of *Fusarium*, though the fruiting bodies of *Ganoderma lucidum* and *Polyporus gilvus* have been invariably found at the base of dead or dying trees. Controversies regarding the pathogenicity of some root- and stem-rotting fungi have been finally set at rest, for Bagchee has shown that *Fomes annosus*, *Armillaria mellea* and *Trametes pini* do play an important rôle in bringing about some of these rots.

But the most important work done during the past decade on forest tree diseases mainly concerns itself, however, with the rusts. Bagchee reports that there are fifteen rusts affecting the conifers alone in our Northern Indian Forests. As a rule, these are heterœcious and have their æcial stages on the narrow-leaved conifers and the telial stages (or the perfect stages) on the broad-leaved plants, usually dicotyledons. Intensive study by Bagchee of the two rusts, *Chrysomyxa deformans* and *C. piceæ* on *Picea morinda* and of another *Chrysomyxa* sp. on *Pinus excelsa*, whose telial stages, strangely enough, occur not on the broad-leaved dicotyledonous plants but on the conifers themselves and whose æcial stages have not so far been discovered, has led to the inevitable conclusion that these rusts have adopted a microcyclic mode of existence abandoning the necessity of passing from one host to another to complete their life-cycles, as they are able to perennate in the mycelial form within the coniferous hosts.

In rusts which are not microcyclic, one of the important tasks of a mycologist is to find out the alternate hosts where the telial stages occur. Bagchee has been singularly fortunate in being able to establish this in three cases, the most important discovery being the matching of *Peridermium brevius* with a species of *Coleosporium*, which Bagchee proposes to name as *C. barclayense*, found on *Senecio rufinervis*.

It must not, of course, be supposed that all fungi found in the forests are harmful. Their rôle in converting leaves, logs, roots and other plant debris into humus and their part in renovating and enriching the resources of nature for the life and growth of new things, have been also briefly referred to. M. B.

* Summary of the Presidential Address (Botany Section) by Dr. K. D. Bagchee, D.Sc., D.I.O., F.N.I., Indian Science Congress, Lahore, 1939.

SCIENCE NOTES AND NEWS

The Complete Solution of the Plateau Problem.—J. Douglas who was the first to have given a complete solution of the Plateau Problem of the existence of the minimal surface with a single contour has now published his partially proved and announced results concerning a very profound generalisation of the problem (*Annals of Math.*, 1939, 40, 205–98). The generalisation consists in proving the existence of the minimal surface bounded by any number of curves $\Gamma_1, \Gamma_2, \ldots \Gamma_k$ and which is of prescribed genus (deficiency or the 1st Betti number r). Courant has also proved the same but has not completely published his proof.

Douglas starts with the well-known conformal representation of the minimal surface due to Weierstrass, *i.e.*, to find n harmonic functions

$$x_i = \mathrm{R}\,[\mathrm{F}_i\,(u + iv)], \text{ where } \sum_1^n \mathrm{F}_i'^2 = 0$$

on a domain of Riemann's surface with the same topological structure in such a way that the n boundary curves of the domain are transformed into the given contours in space. (The deficiency of the Riemann's surface is easily seen to be $r + k - 1$.) Klein's introduction of a symmetric Riemann's surface is of help here. It is a Riemann's surface with an involution T on itself so that pairs of corresponding points correspond to antipodal points on the minimal surface and the boundary curves correspond identically to themselves by means of the involution. The contours in space have to satisfy certain conditions besides being Jordan curves but may cross one another and they may be oriented in any desired way. It may also happen that a single minimal surface may not exist at all, *i.e.*, the solution obtained gives a number of distinct minimal surfaces whose total boundaries are equal to the set (Γ).

One of the artifices employed by the author consists in employing the Dirichlet integral

$$\mathrm{D}\,(\mathrm{X}) = \iint_{\mathrm{R}} (\mathrm{E} + \mathrm{G})\,du\,dv = \iint \left[\left(\frac{\partial x_i}{\partial u}\right)^2 + \left(\frac{\partial x_i}{\partial v}\right)^2\right] du\,dv$$

instead of the usual surface integral

$$\mathrm{I}(\mathrm{X}) = \iint \sqrt{\mathrm{EG} - \mathrm{F}^2}\,du\,dv$$

which is more difficult to deal with. On account of the identity

$$\tfrac{1}{2}(\mathrm{E} + \mathrm{G}) - \sqrt{\mathrm{EG} - \mathrm{F}^2} = \tfrac{1}{2}(\mathrm{E}^{1/2} - \mathrm{G}^{1/2})^2 + \tfrac{1}{2}\left[\sqrt{\mathrm{E}^{1/2}\mathrm{G}^{1/2} + \mathrm{F}} - \sqrt{\mathrm{E}^{1/2}\mathrm{G}^{1/2} - \mathrm{F}}\right]^2$$

which proves immediately the fact that

$$\mathrm{D}(\mathrm{X}) \geqslant \mathrm{I}(\mathrm{X}),$$

he has proved that the two minimal problems are identical.

The next transformation which is difficult consists in transforming these integrals to line integrals along the contours by finding and employing the Green's function for the domain on the Riemann's surface. Douglas brilliantly extends certain simple identities of the theory of elliptic and θ-functions of one variable to identities in the theory of multiple θ-functions (by means of these and the ρ-abelian integrals of the first kind on the Riemann-surface the Green's function is expressed) and the functions corresponding to the Weierstrassian functions and makes use of them in an interesting way. The advantage of this transformation is this. The Dirichlet-Functional (the area functional is more easy) is more difficult to deal with than the functional formed by the line integrals. He shows that the latter functional is lower semi-continuous and that the total set of all surfaces bounding the contours (omitting certain improper ones) forms a compact set. Hence the existence of the minimal surface follows immediately.

These are only the bare outlines of the proof. The problem is extremely complicated and it is really a pleasure to see that this famous problem of the latter half of the previous century is solved with extreme generality. Almost all types of surfaces (with any topological structure) can be experimentally constructed by means of soap films.

K. V. I.

* * *

The Mesotron.—The probable existence of a new type of particle intermediate in mass between the electron and proton has been suggested by Anderson and Neddermeyer (1937) as constituting the hard component of cosmic radiation. Remarkably enough such particles were postulated by Yukawa (1935) to explain the exchange forces between proton and neutron without introducing the neutrinos as would be necessary on the β-decay theory. It has further been shown by Frölich, Heitler and Kemmer that the heavy electron theory can also be made consistent with the observed magnetic moments of neutron and proton. This intermediate particle has been designated by various workers by different names as heavy electron, yukon, barytron, and mesotron or meson. This last name appears to be the one favoured by most physicists. In the short interval of two years, there has been a very large number of papers written on the mesotron, and it appears to play a very important part in cosmic ray theory. A most important suggestion is that of Euler and Heisenberg that a mesotron can disintegrate into an electron and a neutrino, the heavy mass of the mesotron appearing in its offspring as great kinetic energy. This assumption explains the observation of cosmic ray workers that the hard component is much more reduced in intensity in passing through air than through an equivalent amount of dense lead, as has been shown by Rossi, Blackett and others. Heitler has also shown that the nuclear proton-proton force can be explained by assuring a neutral heavy particle (or *neutrelto*), and a new evidence for such a particle has recently been given by F. R. Shonka (*Phys. Rev.*, 1939, 5, No. 1, p. 24) which, however, requires confirmation. Bhabha has pointed out (*Nature*, Feb. 18, 1939,

p. 276) that the theory of the mesotron introduces a fundamental length, and connects this theory with Dirac's recent work on the point electron. The mesotron promises to play a very important part in nuclear theory, and provides ample material for theoretical speculation, adding as it does, a new type of particle intermediate between the light and heavy particles.

* * *

A New Type of Nuclear Reactions.—A new and important type of nuclear reaction has been reported by Hahn, Meitner and Strassman of the bombardment of uranium by deuterium neutrons, and the resulting disintegration leading to the production of a barium isotope ($Z = 56$). This has been confirmed by workers at Columbia University, Carneigie Institute at Washington, and John Hopkins University. Such a reaction would be inexplicable on the older nuclear theories, but appears to be a brilliant confirmation of Bohr's recent theory of nuclear processes as being really double transitions with the formation of a compound nucleus as an intermediate stage. This theory explains very simply the resonance phenomena of nuclear physics, and it has been suggested that the above nuclear reaction of disintegration of uranium by neutrons is such a phenomenon. On Bohr's liquid drop model the disintegration into a Ba-nucleus is exactly like the fission of a liquid drop into two. Further work with thorium is being continued in the same direction.

* * *

A New Stable Isotope.—Another gap in the list of stable isotopes has been filled by the work of Joliot and Zlotowski who report (*J. de Phys.*, *T.* 1938, 9, No. 10, p. 403) the formation of a stable isotope of helium (He^5) of mass five formed by the collision of He^4 and deuterons. Fuller data regarding the binding energy of this nucleus would add considerably to the theoretical development of the lighter nuclei.

* * *

The Differential Analyser.—This instrument giving a mechanical method for integrating differential equations which are not exactly integrable was devised about eight years ago by Dr. Vannevar Bush of the Messachusetts Institute of Technology. The superiority of this method over all other approximate methods has now been definitely established and the instrument is very widely used in electrical Engineering problems as shown recently by Hartree and Nuttal (*J. Inst. Elec. Eng.*, No. 503). It can also be used with great advantage in calculations with cosmic ray data (see for *e.g.*, Lemaitre and Vallarta, *Phys. Rev.*, 1936, **50**, 493; and A. Hunter, *ibid.*, Jan. 1939, **55**, No. 1, p. 15). It might perhaps also be mentioned here that Dr. Bush, who has recently devised a new instrument called the "Cinema Integraph", has been appointed President of the Messachusetts Institution.

* * *

Non-Stoicheimetric Oxides.—Until the end of 1933, it was assumed that the complex oxides can be properly formulated in terms of the simpler members of the series, *e.g.*, Cr_3O_{10} was formulated as 3 CrO_3, Cr_2O_3 and Pb_3O_4 as 2 PbO_2. PbO_2. In 1934, Klemm and Hass (*Zeit. Anorg. Chem.*, 219, 82) showed from paramagnetic studies that nickel oxide can never exist as NiO_{1000}. A similar departure from the law of constant proportions appears to be shown by cupric and ferrous oxides, and by ferrous sulphide. It would thus seem likely that the oxides of metals of variable valency are not exactly stoicheiometric compounds, and may also vary slightly in composition between well-defined limits. A. Cameron, E. H. Harhard, and A. King (*J.C.S.*, 1939, p. 55) have studied a large number of oxides of chromium, and find that chromic anhydride decomposes in two stages with the formation of two non-stoicheiometric oxide ranges $CrO_{2\cdot6}$-$CrO_{2\cdot2}$ and $CrO_{1\cdot7}$-$CrO_{1\cdot0}$. Many of the "oxides" reported in the literature hitherto have been shown to be in one or other of these stability ranges.

* * *

The Mould Fungi of India.—Because of their role in decomposing unwanted organic matter and their use in alcoholic and cellulose fermentations, in the preparation of food products, vinegar and other organic acids, the mould fungi affect us very closely. A study of some of these organisms made by Chaudhuri *et al* (*Proc. Ind. Acad. Sci.*, 1938, 8, 79–99) is, therefore, a step in the right direction. The papers are designated "Molds of the Punjab" but information on all the known Indian *Aspergilli* and *Penicillia* is given in the two papers so far published. Of the thirty-one species of *Aspergilli* recorded by Chaudhuri, *Aspergillus polychromous* De Mello is not accepted as a species by Thom and Church (*The Aspergilli*. p. 137), while *A. sachari* Chaudhuri and *A. humicola* Chaudhuri and Sachar are not considered as deserving of separate specific rank by Blochwitz (*Ann. Myc.*, 1935, 33, 240). Blochwitz thinks that the former may be *A. quercinus* and the latter, *A. flavus*, from the given descriptions. The identification of one isolate as *A. calyptratus* is also doubted, which, he thinks, may be *A. fumigatus*. Blochwitz complains that in spite of repeated requests, he was unable to obtain cultures of *Aspergilli* described by Chaudhuri and a similar complaint is made by Thom and Church regarding De Mello's species. The mould fungi are the most difficult to identify. Cultures of moulds, especially of new species, should invariably be deposited in a central place both for the use of specialists for the confirmation of determinations and the industrial chemists who can harness them into some use.

M. B.

* * *

Nephridia in the Indian Leech, *Hirudinaria*.—Our knowledge of the excretory and associated organs of *Hirudinaria* is brought up to date by the extensive observations of M. L. Bhatia on the nephridia and "funnels" of the Indian leech (*Quart. Journ. Micros. Sci.*, 1938, **81**, Pt. I, Dec. 1938). Though *Hirudinaria* resembles the European leech *Hirudo* which is described in numerous text-books on Zoology, the true detailed structure and interpretation

of the functions of the various organs are not known conclusively. There are 17 pairs of nephridia in *Hirudinaria,* each consisting of the initial, the apical, the inner and the main lobes, and the vesicle and its duct. The cells of the different lobes form intracellular canals forming a network through the nephridium. The vesicle is a non-contractile bag; it is formed as an epidermal ingrowth during development and later acquires a connection with the nephridium proper. Remarkable ciliated structures called "funnels" occur in association with the nephridium in all the segments except the first six. These have no connexion with the nephridium in the adult, but in the embryo the funnel is a solid mass of cells continuous with the nephridium. The "funnel" is not a degenerate structure as was supposed by many previous workers. Its structure really reveals a large number of smaller funnels opening into a central reservoir. The reservoir is the seat of the manufacture of corpuscles which are thrown out through the funnels into the surrounding perinephrostomial sinus.

* * *

Hyderabad Geological Survey.—The latest number of the *Journal,* Hyderabad Geological Survey (Vol. III, Pt. 2), which has been just published, contains six reports embodying the work done by the several officers of the Survey during the last year. Messrs. L. S. Krishna Murthi and H. S. Krishna Murthi contribute a Note on the Test Bore-holes for the investigation of brine along the Sarjapur Nullah, Raichur District—a locality where a large number of salt works are already in existence producing a considerable percentage of good edible salt, and which also affords quick and easy transporting facilities, being situated on the main road to Raichur. Dealing with another aspect of economic geology in the State, is the paper by the late Capt. L. Munn and Dr. C. Mahadevan, regarding the possibility of making Portland Cement in the vicinity of the proposed dam site across the Kistna in Nalgonda District, Wazirabad limestone area, and at Macherla, Guruzala Taluk, Guntur District. There is also a valuable Note on the Marble deposits near Yellandu in Warangal District, by Mr. Syed Kazim and Dr. C. Mahadevan, in which the authors have given an account of the white, yellow and grey marbles seen about four miles north of Yellandu and have also gone into the question of whether suitable quality of marble is available to be worked, and if so, what would be the quantity available in the area where quarrying operations are under contemplation.

Among the other papers published in the *Journal,* may be mentioned (i) Notes on Deccan trap in parts of Gulbarga and Osmanabad Districts, by Dr. C. Mahadevan and Mr. L. S. Krishna Murthi, and (ii) Correlation of some acid members with the auriferous quartz veins in association with Dharwar formations in the western portion of the Raichur Doab, by Mr. S. K. Mukherjee.

The contents of the *Journal* constitute an impressive record of the varied activities of the Hyderabad State Geological Survey Department, and the general get-up of the publication is quite good.

* * *

Metal-Mining Enterprise which formed the subject of the Warington Smyth Memorial Lecture, delivered sometime back, by Professor S. J. Truscott, at the Royal School of Mines, London, has been published as a booklet ("Metal-Mining Enterprise" by S. J. Truscott. Warington Smyth Memorial Lecture, 1938. Macmillan & Company, London, 1938, pp. 38. Price 1*sh.*). The theme of the lecture forms, mainly, a brief review of the progressive use which man has made of the metals from the early times to the present day.

The lecturer states that the bright colours of the metals, like the glittering yellow of the pellets of alluvial gold and the bright red of heavy native copper, caught the attention of the early man who, discovering some of the physical properties of these metals, used them for his needs; gold as an ornament, and copper for his implements. Later, he seems to have realised that copper when heated was more pliable than the cold metal as found in nature, and on melting, different pieces of copper could be welded together to any required mass. A knowledge of these properties of the metal led to its wide use at this early period which may be called the Copper Age. In regions where some tinstone was associated with copper, an accidental mixture of the former along with molten copper led to the chance discovery of the useful alloy, which we now know as Bronze. The alloy being found better than copper, was then largely used during the period, known as Bronze Age, which came to an end some 4,000 years back. Some time after, about 3,000–4,000 years ago, the production of iron from its ores was discovered, and this gave rise to the Iron Age which has become eventually the present Steel Age. Silver and lead are also stated to have been in use during the ancient periods.

Though all these metals were used by the early man and their practical use was extended for different purposes by the succeeding generations, yet the art of metallurgy developed rather slowly till the end of the nineteenth century, since when the progress has been rapid. After this introductory account of the progressive use of metals the lecturer gives some statistical figures showing the rate of increase of production of the several metals, within the past one hundred years, including nickel and aluminium which have come into general use within this present century. The progress of civilisation has created greater need for the metals, and the demand for them is at present much greater than that for *consumable* goods, like vegetable and animal products; and the lecturer thinks that this demand for metals will continue to increase though at a slower rate.

The lecturer then proceeds to a consideration of the price of metals in relation to their cost of production, demand, international control of markets, etc., Metal-mining enterprise is a risky and speculative venture, and the real worth of any metalliferous deposit depends

upon several fluctuating factors. A metalliferous deposit which may be regarded as practically useless at one time, may attain a considerable importance at another. Huge mechanical appliances for breaking and handling large masses of ore bodies, and improved methods of ore concentration by flotation have brought down the cost of operation considerably in large-scale metal-mining enterprises. The extensive use and the wider application of some metals in modern industries have given an added impetus for their large-scale mining and utilisation. Of such, aluminium and magnesium may be mentioned. The lecturer surmises that in days to come suitable methods may be devised to extract economically aluminium from the common clay, and magnesium, from the largely available deposits of dolomites, when even these common materials may become of considerable value. Similarly many other metals like beryllium, platinum, etc., which are so very rare and difficult to get now may be produced in larger quantities considerably cheaper.

The lecturer has dealt with his subject in a masterly way and those who desire some general information on the present status of metal-mining as a financial enterprise will find the book to be of absorbing interest.

B. RAMA RAO.

* * *

Grasses of Assam.—A list of the known grasses of Assam is given in a publication just brought out by the Forest Research Institute, Dehra Dun, in its *Indian Forest Records*, New Series (Botany).

The importance of the study of grass has been recognised in many parts of the world. Unfortunately, India has lagged behind. The present work, therefore, in which details are given of the grass resources of Assam and a number of grasses new to science are described, marks an important advance in the study of the subject.

Assam, with its tropical temperature, its abundant rainfall and its copious supply of underground water, presents all the essentials of a forest climate as understood by ecologists. The climax vegetation of the Province is, therefore, taken to be a tall forest of evergreen trees.

From very early days, however, a large portion of the Assam plains has been covered by a savannah of tall coarse grasses, which are not relished by cattle; but cattle will eat them in default of anything else. The young leaves and stems, which are sent up by the underground rhizome at the close of the annual fires, are acceptable and are greedily eaten by cattle. Hence the practice of herdsmen is to fire the savannah as early as possible in order to induce the appearance of the tender shoots.

The tall grasses are broken down and each new shoot is browsed off as soon as it appears. Palatable grasses may appear if the locality is favourably placed but they are selectively grazed and are soon eliminated.

At the same time, important changes are taking place in the upper layers of the soil. They are impacted by the hooves of the cattle and the soil becomes drier owing to the removal of the heavy vegetation. The stage is now set for the appearance of deep-rooted perennials which make no far-reaching demands upon the factors of the habitat, and perennials which possess special adaptations which enable them to survive in the face of heavy grazing. Unless new arrivals are adapted to withstand continual browsing they cannot survive, because any erect grass is immediately eaten to the ground.

Therefore the elements required by a plant which has any expectations of survival in closely-grazed pasture are that it must be (1) protected in some way that enables it to use its green parts for photosynthesis, (2) a species which possess an efficient means for the dispersal of its seeds and (3) able to adapt itself to very diverse edaphic conditions.

* * *

Atmospheric Electricity.—A scientific note of the Indian Meteorological Department (Vol. VII, No. 79) by Mr. S. M. Mukherji discusses the results of atmospheric electric observations made at the Colaba Observatory during the period July 1935 to August 1936.

It has long been known that in fair weather, the earth's surface has a charge of negative electricity and that near the ground, the electric potential increases with height at the rate of about 100 volts per metre.

The presence in air of electrified particles or ions causes a small conductivity. The positive ions move towards the side of decreasing potential and *vice versa* causing an "air-earth current".

These quantities are never steady but change with meteorological conditions. During the cold season in Bombay, for example, the potential gradient is very large in the early mornings but decreases in the afternoons. The conductivity changes are in the opposite direction. These changes depend mainly on the presence of haze or fog in the atmosphere.

Of the few systematic observations of these quantities made in India, the earliest observations were those taken at Simla by Simpson in 1910.

In 1930 a small room in the northeast corner of the grounds of the Colaba Observatory, Bombay, was set apart for atmospheric electric observations. For measurements of potential gradient, a radium spiral collector was installed, projecting outside the room through a hole in the western wall at a height of 170 cm. above the ground. Normally the distance between the radium spiral and the wall was kept at 40 cm. but this was altered suitably if any abnormalities in potential gradient were expected. It was clear at the very outset that there were two types of variation of the potential gradient, one characteristic of the southwest monsoon and the other of the dry monsoons. In 1936, therefore, the observations of potential gradient were supplemented by those of atmospheric electric conductivity. From the potential gradient and the conductivity it is possible to calculate in a simple manner the small electric current that flows from the atmosphere to the earth or *vice versa*.

The mean monthly potential gradient has been found by Mr. Mukherji to be maximum in mid-winter and minimum in May. The

conductivity varies roughly inversely to the potential gradient.

The average value of the potential gradient at Bombay was 150 volts metre and conductivity $2{\cdot}5 \times 10^{-4}$ electrostatic units and of air-earth current $5{\cdot}9 \times 10^{-7}$ electrostatic units or $2{\cdot}0 \times 10^{-16}$ amperes per square centimetre of the earth's surface.

* * *

Toxic Gases in Industry.—The Department of Scientific and Industrial Research has issued two further leaflets in the series describing standard methods for the detection of poisonous gases produced in industrial processes. These deal with sulphur dioxide and benzene vapour respectively. (Leaflets Nos. 3 and 4, H. M. Stationery Office, London.)

A concentration by volume of one part of sulphur dioxide in 2,000 is dangerous for even short exposures and one part in 100,000 is the maximum concentration allowable for several hours' exposure. The standard method developed for the detection of this gas depends on drawing a sample of the atmosphere by a hand-pump through test-paper treated with starch and potassium iodate to which potassium iodide has been added. The test-paper becomes stained a brownish colour and the concentration is determined by comparing the stains with a standard colour chart supplied with the leaflet. Concentrations down to one part in 250,000 can be estimated by making not more than ten strokes with the hand-pump. Complete instructions for carrying out the test are given in the leaflet.

In high concentrations benzene vapour acts as a narcotic (acute poisoning). In low concentrations over a prolonged period, it affects the blood and the blood-forming organs of the body (chronic poisoning). Individual susceptibility is well recognised, women and young persons being particularly liable to suffer from chronic poisoning.

Analyses of air in factories where poisoning has occurred give values ranging from 1 in 200 to 1 in 500 parts of benzene.

The chemical test recommended in the leaflet is capable of detecting concentrations down to 1 part in 10,000. The test involves the absorption of benzene vapour in concentrated sulphuric acid containing a trace of formaldehyde. An orange brown colour is produced, even traces of benzene being sufficient for this result. The test is carried out by drawing a sample of the atmosphere under test through a tube containing the reagent by means of a hand-pump of definite capacity, and determining the number of strokes required to produce a certain standard depth of colour. From the number of strokes of the pump required to produce the standard colour, the concentration of benzene vapour present is obtained by reference to the table given in the detailed instructions in the leaflet.

* * *

Fibre from Willow Bark.—The latest *Bulletin* of the Indian Central Jute Committee (No. II, February 1939), gives some details regarding a German patent for breaking up willow bark. "Tannic acid is first extracted from the peeled bark by means of water, after which the bark is boiled for several hours at a pressure of 1 to 3 atmospheres in a 3 to 4 per cent. solution of caustic soda or sodium sulphate. It is then treated with a mixture of about 1 part sulphurous acid, 3 parts hydrochloric acid, and 10 parts water. The fibre produced in this way is specially well adopted for mixing with flax, wool and jute leading to the production of a fabric with new and valuable properties."

* * *

Unification of Pharmacopœiæ.—The potential value of the creation of a limited international pharmacopœiæ has long been realised by medical men and is frequently brought home to the individual patient by the difficulty he experiences in getting his prescriptions made up when abroad. The same problem exists with regard to the treatment of ships' crews calling at different ports and the replenishment of ships' medical chests.

From the academic point of view, the existing variations in the strengths and composition of medicinal preparations in different national pharmacopœiæ add an unnecessary complication to the investigation of the comparative results in drug therapy of the same disease in different countries, and further tend to prevent the adoption of new methods of treatment by a country, even where these have proved valuable elsewhere.

Apart from the view of the practitioner, consideration must also be given to the manufacturer who, from one country, is supplying large quantities of drugs to the international market. The varying standards as to strength and particularly as to purity at present existing make it essential for a producer, either to limit his sales to his own country, or to manufacture a special preparation of the same drug for each country to which he is exporting.

The field of possible unification of pharmacopœiæ had already been explored by an International Conference, meeting at Brussels in 1925, the outcome being a Convention creating an International Secretariat, under the Belgian Government. In addition, the International Pharmaceutical Federation had worked along similar lines. A further step forward was taken in 1937, when, after agreement with the Belgian Government and in *liaison* with the International Pharmaceutical Federation, the Health Organisation set up a Technical Commission of Pharmacopœial Experts. This Commission met in Geneva during 1938 and prepared a programme of studies, including the selection of suitable drugs for examination.

The Commission further considered and adopted standard forms of monograph for use in preparing the drafts, and decided to prepare general descriptions of reagents and analytical procedures and statements of other general principles for the unification of monographs. The preparation of a report on maximum doses and on the possibility of defining average doses was entrusted to two members of the Commission.

Finally, the members agreed to prepare a number of draft monographs on various drugs, sixty of which have already been received. The monographs will be subsequently considered at a meeting of the Commission in May

1939, when the final form will be discussed and approved, and will then be forwarded to the Permanent Secretariat in Brussels for circulation amongst the signatory countries of the Agreement, with a view to their ultimate adoption and final incorporation into a limited international pharmacopœia.—(*Chronicle of the Health Organisation*, League of Nations, *February* 1, 1939.)

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League of Nations.—The latest Bulletin of the Health Organisation of the League of Nations (Vol. VII, No. 5), contains information concerning the activities of the Organisation from August to October 1938, and is specially devoted to the question of biological standardisation.

This number reproduces an important report on the meeting of the serologists of the Permanent Commission on Biological Standardisation held at Paris in October 1938. The report is accompanied by a number of annexes relating to tetanus antitoxin, anti-snake venom serum and gas gangrene anti-toxins. The volume also contains studies on the international standard of vitamin B, and the Report on the Third International Conference on the Standardisation of Hormones, held at Geneva in August 1938.

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At a Symposium on Food and Drug Adulteration held under the joint auspices of the **Association of Technologists, Mysore**, and the **Institute of Chemistry of Great Britain & Ireland** (Indian Section), under the presidency of Sastravaidyapravina Dr. S. Subba Rao, B.A., M.B.B.S., M.R.C.S., Senior Surgeon with the Government of Mysore (Retd.), on Sunday, the 12th March 1939, in the Mayo Hall, C. &. M. Station, Bangalore, the following resolution moved from the Chair, and seconded by Dr. L. R. Govardhan, Health Officer, C. &. M. Station Municipality, was adopted:

> "This meeting of the Association of Technologists, Mysore, the Institute of Chemistry of Great Britain and Ireland (Indian Section) and other scientists and public health authorities is of opinion, that in view of the widespread prevalence of adulteration of foods and drugs in this country, and the absence of effective methods of controlling it, immediate steps should be taken by the governments and public bodies concerned, to (1) introduce suitable standards for the various foods and drugs; (2) introduce suitable legislation to secure more effective control; and (3) appoint public analysts and devise other effective machinery for the detection and prevention of adulteration.
>
> It is suggested that a committee may be appointed to go into the question in Mysore State and representatives may be included from the Association of Technologists and the Institute of Chemistry".

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Indian Zoological Society.—The inaugural meeting of the Indian Zoological Society was held on Saturday, the 7th January 1939, at 3 P.M. in the Zoological Laboratory of the Government College, Lahore. Dr. B. L. Bhatia presided.

The President read out some of the letters received from the members of the Organisation Committee. He reported that 82 zoologists had joined the Society as Foundation Fellows in response to the circular letter issued by him.

Dr. Bhatia then placed before the meeting the draft constitution of the Society which had been prepared by the Organising Committee and this was accepted with a few amendments.

The following Office-bearers were elected:—PRESIDENT: Dr. B. Prashad (*Calcutta*); VICE-PRESIDENT: K. B. Mohd. Afzal Hussain (*Lahore*); SECRETARY: Dr. H. K. Mookerjee (*Calcutta*); and BUSINESS MANAGER OF THE JOURNAL: Dr. B. L. Bhatia (*Lahore*).

Fifteen names were then duly proposed and seconded for election as Ordinary Members of the Council, and the following seven were elected by ballot:—Prof. R. Gopala Aiyar (*Madras*), Prof. B. K. Das (*Hyderabad*), Prof. A. B. Misra (*Benares*), Prof. C. R. Narayan Rao (*Bangalore*), Dr. Hamid Khan (*Lyallpur*), Mr. Inayat Ali Khan (*Aligarh*), and Mr. Guran Lal Arora (*Lahore*).

Lahore was selected as the Headquarter of the Society.

* * *

Society of Biological Chemists, India.—The Ninth Annual General Meeting of the Society of Biological Chemists, India, was held at 2-30 P.M., on Saturday, 7th January, in the University Hall, Lahore. In the unavoidable absence of the President Sir U. N. Brahmachari, Dr. S. S. Aiyar took the Chair.

The annual report and accounts of the Society were presented by the Secretaries and adopted.

The following were elected Office-bearers for the year 1939:—

President: Sir Upendranath Brahmachari; *Vice-Presidents*: Dr. G. J. Fowler, Rao Bahadur B. Viswa Nath, Lt.-Col. S. L. Bhatia and Mr. R. C. Srivastava; *Hon. Secretaries*: Dr. C. N. Acharya and Mr. B. H. Iyer.

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Benares Hindu University.—Mr. S. Ram Mohan Rao, M.SC., who carried on researches for four years under Professor A. B. Misra on the *Coccidæ* has been awarded the D.Sc. degree by the Benares Hindu University on the recommendations of Prof. R. Newstead, F.R.S., of the Liverpool University and Mr. F. Laing of the British Museum (Natural History Section) in London.

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Dr. A. B. Misra, Professor of Zoology in the Benares Hindu University, was elected President of Section 3(A), dealing with Insect Morphology, Physiology and Embriology at the VII International Entomological Congress recently held in Berlin.

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Dr. C. G. Pandit, Director, King Institute, Guindy, has been awarded the **Minto Medal** for the year 1938 in recognition of his work on virus diseases. The Medal, which is of the value of Rs. 500, is awarded annually for "distinguished work in tropical medicine by an Indian".

Third All-India Obstetric and Gynaecological Congress.—The third All-India Obstetric and Gynæcological Congress will be held in Calcutta during December 1939. The exact date will be notified at a later date. The chief subjects selected for discussion are:—

(1) Functional Uterine Hemorrhage;
(2) Anemia of Pregnancy; and
(3) Maternity and Child Welfare.

Further informations can be obtained from the Secretary, Bengal Obstetric and Gynæcological Society, Calcutta Medical Club House, 91-B, Chittaranjan Avenue, Calcutta.

* * *

Lady Tata Memorial Trust.—Applications are invited for five scientific scholarships of the value of Rs. 150 each for the year 1939–40.

The scholarships are open to men and women and will be tenable for a period of twelve months commencing from the 1st July 1939. Any or all the scholarships may be extended for a further period of twelve months within the discretion of the Trustees. All old scholars who desire renewal should re-apply.

Applicants, who must be of Indian nationality, must be Graduates in Medicine or Science of a recognised University. They must undertake to work whole-time and will be debarred from private practice. In the duration of the period of his scholarship or award, the recipient of the benefit shall devote himself to the work before him to the entire satisfaction of the Trustees, who reserve the right to withdraw payment on the recommendation of the Advisory Committee.

The subject of scientific investigation which they may select must have a bearing directly or indirectly on the alleviation of human suffering by disease.

Applications must be forwarded through the Director of a recognised Research Institute or Laboratory where the candidate proposes to work, and must be accompanied by a letter from the Director stating that he has critically examined the details of the proposed research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation and give laboratory facilities.

Applications must give (*a*) a short resume on the subject indicating present state of knowledge and (*b*) details of the proposed research, indicating (*i*) the methods intended to be employed, (*ii*) previous experience in the use of these methods and (*iii*) the experiments to be carried out.

Applications, which must be typed, must give full particulars in the order indicated above and must be addressed to the Secretary, The Lady Tata Memorial Trust, "Bombay House," Bruce Street, Fort, Bombay, so as to reach him not later than 7th April 1939.

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Government of India: Industrial Research Council.—The Government of India offer the following prizes for the papers dealing with researches of industrial importance:

1st Prize of	Rs.	1,000
2 Prizes of	,,	500 each
2 ,, ,,	,,	250 ,,
3 ,, ,,	,,	150 ,,

Particulars of the terms of the competition and entry forms may be obtained free of cost on application to the Director, Industrial Research Bureau, Imperial Secretariat, New Delhi. Entries will be accepted only on the official forms provided.

Papers must be submitted not later than the 1st June 1939.

* * *

Deutsche Akademie.—On the occasion of its tenth jubilee year the Indian Institute of the "Deutsche Akademie" in connection with the study group "Das Ahnenerbe" has selected in October 1938 the following subject for a competition: *"Symbols in India, their meaning, historical development and present position."*

This competition is open only to Indian scholars who have already graduated and completed their study.

All papers must be submitted on or before the first of April 1940.

The first prize is a scholarship for one year in a German university town including the costs for the journey from India to Germany and back.

The second prize is a scholarship for one year in a German university town but exclusive of the costs of the journey.

The third prize is a scholarship in a German university town for half a year and exclusive of the costs of the journey.

The winner of the first prize will receive a monthly stipend of RM. 300—during his stay in Germany. The winners of the second and third prize will receive a monthly stipend of RM. 200—each.

All winners will receive in addition the journal of the "Deutsche Akademie" and one of the journals of the study group "Das Ahnenerbe" according to their own choice free for three years.

The India Institute of the "Deutsche Akademie" acquires the right to print and publish any of the prize winning papers. The printed papers will bear a notice showing them to be the prize winners in the competition of the India Institute of the "Deutsche Akademie" and of the study group "Das Ahnenerbe".

Papers which have not been awarded a prize will be returned. The Committee however cannot undertake any responsibility with regard to the reading and returning of any paper that may be submitted to them.

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International Centre for the Identification of Salmonellae.—In pursuance of the recommendation adopted by the International Association of Microbiology, an International Centre for the identification of Salmonella Strains has been set up, thanks to a grant from the Commonwealth Fund, at the State Serum Institute, Copenhagen, under the direction of Dr. F. Kauffmann. With a view to facilitating the serological identification of Salmonellæ in all countries, this centre is willing to distribute the necessary immune sera and standard cultures free of charge, and to study any aberrant strains sent to it. It also proposes to stimulate the establishment, in every country, of national centres equipped for the identification of Salmonella strains, which would thus be in a position to meet the requests for agglutinating sera made by scientific workers in the country concerned.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

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February 1939. SECTION B.—RAMA NAGINA SINGH: *The Myxophyceæ of the United Provinces, India, IV*—deals with some of Myxophyceæ that have not been recorded from the U.P. JAGJIWAN SINGH: *A Contribution to our knowledge of the Indian Soil Actinomycetes.*—The actinomycetes do not show any marked seasonal variation in population. V. PURI: *Studies in the order parietales, II.—A Contribution to the Morphology of* Garcinia livingstonii *T. Anders.* M. C. CHERIAN AND MOHAMED BASHEER: Tetrastichus sokolowskii *Kurdj* (Family Eulophidæ)—*A Larval Parasite of* Plutella maculipennis *in South India.*—The habits and life-history of the parasite are described. H. S. RAO: *Cuticular studies of Magnoliales.*—The Magnoliales have not been directly derived from Bennettitales, and synthetic types combining the characters of the Cycadales, the other haplocheile gymnosperms and the angiosperms are to be found in this small group.

Indian Association for the Cultivation of Science (Proceedings):

December 1938.—A. C. BANERJI AND P. L. BHATNAGAR: *On the Intensity of Ionisation in the Earth's Atmosphere.* A. BALANKESWARA RAO: *The Spectrum of Argon IV.* L. SIBAIYA: *On the excitation of Chladni Figures.* S. K. BANERJI: *On the Interchange of Electricity between solids, liquids and gases in mechanical actions.* MOHINIMOHAN GHOSH: *Dynamics of the pianoforte string and the hammer, Part II.* S. K. MITRA, J. N. DHAR AND S. P. GHOSH: *The lower ionosphere.*

Indian Chemical Society:

November 1938.—S. S. BHATNAGAR, P. L. KAPUR AND MAHBUB SHAH HASHMI: *Phototropy and photochemical isomerism from the magnetic Standpoint.* N. R. DHAR AND S. K. MUKERJI: *Denitrification in sunlight and its retardation, Part IV.* W. V. SUNDARA RAO, P. V. KRISHNAMURTI AND G. GOPALA RAO, *Mechanism of the Micro-biological oxidation of ammonia. Part I—Formation of intermediate products.* JAMIAT V. LAKHANI AND RUSTOM P. DAROGA: *The determination of the parachors of inorganic salts in solutions. Part III—The parachors of some salts of magnesium, strontium and barium, and the atomic parachor of the above elements and radium.* R. CHATTERJEE: *Oxalenediamidoxime. Part I—Estimation of nickel.* S. C. GANGULY: *On the estimation of fumaric and maleic acids.* BALWANT SINGH: *Note on oxidation of ferrous iron with potassium iodate.*

Meteorological Office Colloquium, Poona:

February 3, 1939.—N. K. SUR: *Lange's Radio Meteorograph. February* 14, 1939.—K. R. RAMANATHAN: *The Earth's Magnetism and the Upper Atmosphere.*

Fourthcoming Event

April 7-8, 1939.—A convention of Technologists and a Symposium on MATERIALS OF CONSTRUCTION FOR THE CHEMICAL INDUSTRY will be held at Bhadravati under the joint auspices of the *Association of Technologists, Mysore* and the *Technical Association, Bhadravati.* The convention will be opened by Rajasevaprasakta A. V. Ramanathan, Chairman, Mysore Iron and Steel Works. Sir C. V. Raman, KT., F.R.S., N.L., will preside over the Symposium.

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Zoological Survey of India

IN our Editorial of December 1935 attention was directed to some of the important activities of the Zoological Survey of India during the years 1932–35, and the hope was expressed "that the authorities while Indianising the services, will also provide them with the necessary means of maintaining their high standard of efficiency and traditional reputation". It is with sincere regret, therefore, that we find, in the triennial report of the Department for the years 1935–38, recently issued by the Director, that the curtailed activities of the Department, following retrenchment in civil expenditure in the year 1931–32, had not been materially restored even during the period covered by the last report. So long as there is no Committee of Scientific Advice, as envisaged by us in 1935, to educate our Legislators and Civilians, in whose hands lie the destinies of even the expert scientific services, it is perhaps useless to expect a fair deal for all scientific and similar activities. We do not blame the Governments for not providing funds for scientific investigations, but at the same time we are definitely of the opinion that, for want of a central organisation to co-ordinate scientific activities of the various services on a national basis, considerable portions of the funds already provided are not properly spent, with the result that there is duplication of work in some fields and starvation of legitimate activities in other spheres. In view of the uncertainties in the international situation and the rôle which science must play in the event of any war, is it not proper for the Governments of the country to devise ways for utilising to the best advantage the scientific resources of the country, both in men and material? In our opinion this can only be done by having a Board of Scientific Advice on the same lines as in Great Britain or some other countries.

The curtailment in the activities of the Zoological Survey was effected in 1931–32 on the advice of the General Purposes Sub-Committee of the Retrenchment Advisory Committee, which unfortunately did not include even a single scientist. The recommendation naturally, therefore, could not be based on a proper consideration of the importance of the activities of the Survey and other scientific departments.

To revert to the Zoological Survey of India, the activities of the Department as revealed in its two reports, seen by us and covered by a period of six very lean years of its working, leave no doubt that there is a considerable difference in the functions of the zoological departments of the universities and the Zoological Survey of India. For instance, during the period under report, the Zoological Survey of India, in addition to attending to the needs of the Indian Museum and to innumerable minor enquiries of various types, carried out detailed investigations in connection with (*i*) shell fisheries in the Andamans and their economic exploitation; (*ii*) biological investigations at Pulta near Calcutta in connection with the water supply of Calcutta, and at Senchal lakes in connection with the water supply of Darjeeling; (*iii*) special enquiries regarding the rôle of indigenous species of fishes as larvivorous forms in connection with anti-malaria measures; (*iv*) identification of animals of economic importance from the medical or sanitary point of view for various scientific institutions; and (*v*) identification of human and animal remains excavated by the Archæological Survey and other bodies at various prehistoric sites in different parts of India.

The work on the Shell Fisheries in the Andamans was of direct economic importance. The Department was able to establish that the two common types of shell of *Trochus* represented only plastic phases of the widely distributed Indo-Pacific species *Trochus niloticus* Linn. The rate of growth, age at which maturity is attained and the longevity of the species have been worked out. From the survey of the fishing beds it has been ascertained that shell fishing has been carried on to such an extent as to have endangered all commercial possibilities of regular fisheries, and in accordance with the knowledge gained regarding the bionomics of the species an entire stoppage of fishing for a period of three years was suggested to the Andaman and Nicobar authorities.

The biological investigations at the Pulta Water Works also had a very important economic aspect in so far as certain organisms were found to interfere with the proper working of the slow-sand filters. Besides determining the seasonal variation in the fauna of the Settling Tanks, Filter-Beds, etc., the Department found that these variations in the animal populations could be co-related with the presence or absence of aquatic vegetation, the quantity of silt held in suspension and the salinity of water. Several remedial measures were suggested by the Zoological Survey of India, which the Corporation of Calcutta adopted with considerable advantage to the working of the filter-beds. The Department's activities in this connection are stated to have now reached a stage when the data collected and the opinions formed should be tested experimentally in order to devise permanent measures of relief.

It is indeed a great pity that owing to lack of funds the survey activities of the Department had to be greatly restricted. Our knowledge of the geographical zoology of

India is very meagre indeed and when the Zoological Survey of India was established in 1916 one of the functions assigned to it was to collect data about the zoogeography of India. Special mention may, however, be made in this connection to the preliminary survey, during the period under review, of the Santal Parganas, where certain species of fish hitherto unknown from the Eastern Himalayas were found; these have thrown considerable light on the palæogeographical features of the country.

In spite of severe handicaps under which the Department is labouring, the Departmental publications have been kept up-to-date and at an acknowledged high standard. The staff has also published numerous original articles, some of which are of unusual interest and of great merit. The laboratories of the Department, as in previous years, continued to attract a large number of workers from different parts of India and abroad. It is perhaps not generally realised that for zoological research the laboratories of the Zoological Survey of India provide unique opportunities in the East, not only on account of its extensive library, the magnitude and variety of its research collections, and, last but not the least, the expert knowledge of its staff which is available for all research workers.

The improvement effected by the Department in the Public Zoological Galleries of the Indian Museum is evident from the illustrations of some of the exhibits reproduced on three halftone plates that accompany the report. A start has been made by the Department to make the exhibits popular and attractive for the general public. Special mention may be made of the fact that purely scientific labels have been replaced by popular labels in the recently arranged galleries, and in the case of the Fish Gallery labels in Bengali also have been installed.

The details of the activity of the Department can be judged from a perusal of the Appendices A to J, which accompany the report. They contain information regarding the specimens sent to specialists for study or identification; the list of new types and co-types added to the collections; the list of donors; the list of new exhibits in the public galleries; the specimens received for study or identification; the list of Zoologists, Anthropologists, etc., who made use of the Library and Laboratories; the list of publications, official and unofficial; and the additions to the Library.

It is with considerable pride and pleasure that we have commented on the useful work done by the only thoroughly Indianised scientific department of the country. Not very long ago it was openly said that Indians were not scientifically minded, but we are definitely of the opinion that this was based on erroneous assumptions, as very few, if any, opportunities had then been available to Indians for showing their scientific worth. Even now where chance or accident has placed them in suitable positions to carry on scientific work the authorities are not really helpful, as the grants sanctioned in the way of emoluments for their staffs and for the works of the departments are hardly sufficient even to keep them on a maintenance basis, much less to carry on detailed surveys or research work. May we wish and hope with the Director that the work of the Department will be restored to its normal pre-retrenchment level before very long, and that adequate use will be made of its staff in the much-needed economic development of the country.

Applied Research and The Indian Institute of Science, Bangalore*

IT is recognised that the principal objects of the Institute are three-fold, namely, (1) Technological Instruction, (2) Research in Pure Science, and (3) Research in Applied Science. The first two objects are receiving attention to a reasonable extent but the facilities available for achieving the third object have been neither adequate nor clearly specified.

I am giving prominence to applied research because this is an industrial age and production of primary products is comparatively far less profitable than products of industries and manufactures. If you continue importing products of manufacture which the people of this country can produce for themselves, you will not only be paying for them from your slender income in uneconomical occupations, but you will also be increasing unemployment at the same time.

It is unnecessary at this stage to enter into any discussion whether this Institute should give greater attention to research in Pure Science or Applied Science. Both are necessary. Theoretical research is the basis, but it should be linked up and correlated with applied research. If, in some foreign institutions, pure research is given prominence it is because they have their surfeit of industrial income and those countries can afford it. Even there in cases in which the outlay is small as here, more attention is given to practical than to theoretical research. If regard be had to the small sums we are spending, it is incumbent on us to spend a greater portion on practical research than we do at present. A distinguished scientist connected with the General Motors Corporation, Mr. C. F. Kettering, has remarked: 'A development is no good so long as it is in the laboratory. It is only good when everybody in the country uses it.'

A large amount of fundamental research is being done in Europe and America, the results of which may be examined with an eye to their adaptation to local conditions and application to local uses. Pamphlets may be written and articles published in technical journals to spread the result achieved abroad among industrialists and research workers in this country. The professors in the Japanese Universities, within my own observation, are very good at this kind of work. They vie with one another in giving the earliest possible information of foreign discoveries and inventions to their countrymen.

This Institute being an all-India concern, a Bureau for collection of information of value to practical research and to industries should, in my view, be created as one of its independent departments. ..... Notes, files and books giving the latest particulars and state of advance should be maintained in the Institute Library. Business men would themselves come or would send their representatives here to seek information and knowledge, and the service rendered to industries by this means would be of the maximum value for a minimum outlay.

An officer who has knowledge of the working of industries should be attached to the new Information Bureau just suggested by me. He should be able to compile the information required for each branch of industry in collaboration with the professor of the branch of science concerned.

Another point to be borne in mind in this connection is that, in the case of research in applied science in foreign countries, the results of practical value are usually revealed in general terms, while the actual processes which are of commercial value are kept secret. In such cases, secondary research may be profitably carried on with advantage in this Institute to discover such secrets earlier than they are revealed so as to put the results to practical use.

If it gets a reputation for service to industries and industrialists in these matters, the Institute will surely be able to obtain additional funds to extend its scale of working. It is on record that in Great Britain quite recently the research associations increased their resources by 30 per cent. in

* From the Address delivered by Sir M. Visvesvaraya, President of the Court of the Indian Institute of Science, Bangalore, at the meeting of the Court held on March 25, 1939.

two years by working in closer association with industrial firms in this way.

In regard to most of the work I have mentioned, a beginning can be made if the Professors, Assistant Professors and Readers are all of one mind in the matter of encouraging industrial research and making themselves useful to industries. If they are able to meet and discuss the needs of the industries, if all the departments can work in unison for a few months in succession, and if each Professor undertakes some work in applied research in one or two industries, they will soon be beginning to achieve practical results even without requisitioning additional equipment and facilities from the Council. Any such voluntary effort on their part will have a tremendous moral effect, both on the controlling authorities and the industrially minded public. And there will be no dearth thereafter of funds or staff for continuing the work.

The principal measures to this end which suggest themselves to me are:—(1) To get into touch with industries and industrialists and ask what work they want to be done for them at the Institute, and to consider how much of it, it is reasonable to provide for, what part of it, if any, is done at present and what additional funds and facilities are necessary to do the remainder—in other words to work on a plan, (2) To endeavour to set apart from the resources of the Institute, staff, equipment and funds to be specifically devoted to industrial research in future, (3) To announce after careful investigation what information and data the Institute can supply or collect for industrial firms and corporations from outside centres by charging a fee for the purpose, (4) To find out how many industries are willing to employ research workers under the supervision of Professors to work out their problems in applied research.

The country is undeveloped. The unemployment problem is staring us in the face. The resources of the Institute are meagre and the Irvine Committee too has expressed the opinion that concentration on industries and on work of a practical character is our sorest need to-day. At such a time, theoretical research should not be pursued to the extreme extent of overshadowing all work of practical value. It is for this reason that I have suggested that at least half the resources of the Institute and half the time of the staff should be set apart to those branches of applied science that have a bearing on practical pursuits and the income-earning professions of the people.

Some people would like all objects of material gain to be eschewed and the Institute made to do its work in a purely cultural and scientific atmosphere. Have that atmosphere as thick as you like where you can afford it, but in the present circumstances, the country's prime wants—its basic needs —should be the first concern of the Institute. Industries are needed to give work for the unemployed and relief to the distressed. And applied research, which the Institute can do much to encourage, may be regarded as the mother of industries.

The expectation of the public is that the Institute should actively help in the direction of developing industries, training industrially minded young men and creating an industrial atmosphere in the country to promote production and income and raise the standard of living of our people. If this great change be effected, we may then with confidence appeal for larger contributions from Provinces, States and business public generally. But if the Institute remains content with pure science and the creation of a scientific atmosphere, when the tragedy of an illiterate, under-nourished population is being enacted before our eyes, we will not be doing our duty in the spirit of the wishes and ideals of the eminent founder of the Institute. I think, therefore, we must now unhesitatingly revise our notions about practical research, its influence on the country's progress and its place in the scheme of work of this Institute. In the words of the Irvine Committee, we must 'make applied research the first and most responsible duty of the Institute'.

A Preliminary Note on the Catastrophic Chilean Earthquake of January 25, 1939

By S. R. Savur and S. M. Mukherji
(*Colaba Observatory, Bombay*)

THE great circum-Pacific seismic belt which passes through Chile began to exhibit unusual activity in November last and there occurred about half a dozen large or very large earthquakes in the Pacific, to the east of Japan and to the South of Alaska. The disastrous Chilean earthquake of January 25, 1939, appears to be the last of this series and is no doubt, the most catastrophic (in point of destruction of human life and property) of all the earthquakes that have occurred since the Quetta earthquake of the 30th May 1935.

Seismological data for the Chilean earthquake have so far been received here from Kew, Neuchatel, Basel, Zurich, Chur, Stuttgart, Hamburg, Perth, Riverview, Cape Town, Hongkong, Dehra Dun, Hyderabad, Agra and Calcutta. The original seismograms from the last three stations are also available. Except Kew and Cape Town all the stations have recorded the first movement as emergent, while Kew, Zurich, Chur and Hamburg report eP_1' in addition to P. An analysis of the P and P_1' residuals using Gutenberg and Richter's tables[1] show that these data are in satisfactory agreement with the epicentre 36°·3 S. and 72°·2 W. This is about 20 miles to the north of Chillan. The time of origin of the shock is obtained as $25^d\ 3^h\ 32^m\ 12^s$ G.M.T.

Focal Depth

The problem of the depth of focus of the shock appears to present some difficulty. In the opinion of some,[2] the shock was of normal focal depth but Kew estimates the depth at about 75 km. In the Bombay E component a clear phase is recorded 18 secs. after eP_1'. If this be taken as pP'_1 a value of about 60 km. is obtained for the depth. The phase corresponding to 18 secs. is also clear in the Agra E component. Other clear phases, which are identifiable in all the seismograms from Agra, Bombay, Calcutta and Hyderabad, have been recorded at 28–31 secs. and 45–47 secs. respectively from the beginning. Assuming these to be pP' and sP' respectively, a value of 100 km. for the depth is obtained from each of these phases. Therefore these appear to suggest a depth between 60 and 100 km.

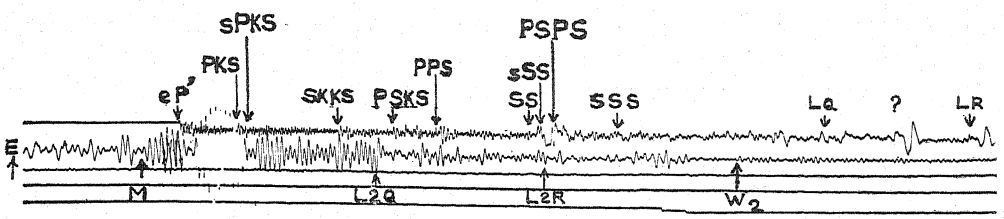
Another phase, namely, SKKS, is exceptionally clear in the Agra and Bombay records and is fairly so in the Calcutta and Hyderabad seismograms. Comparing the observed travel times of SKS and SKKS with Jeffrey's calculated times[3] we get the following values for the depth. Kew: SKS—50 km. and a sSKS (assumed here as SKKS)—50 km.; Neuchatel SKS—50 km.; SKKS at Agra, Bombay, Calcutta and Hyderabad—70, 60, 40 and 50 km. respectively. The mean of these values is 55 km.

We can also examine the question of the depth of focus from the macroseismic data, for, the focal depth of a shock is related to the radius of the area shaken by it and its maximum intensity. From the available data, Gassmann's formula gives 46 km. while Blake's formula 58 km. for the focal depth of this earthquake. The degree of reliability of the results obtained from Gassmann and Blake's empirical relations can be gauged from the fact that they give 12 and 6 km. respectively for the depth of focus of the Quetta earthquake (May 1935) while seismological evidences from a recent study of this shock made at Colaba pointed to a depth definitely less than 10 km. It thus appears probable that the depth of the Chilean earthquake was near about 60 km.

Energy

From the horizontal maximum amplitudes of the ground as recorded at C. Town (N,E), Kew (N,E), Bombay (N,E), Hyderabad (N,E), Hongkong (N,E), Agra (E) and Calcutta (N) we get 7·5 as the mean value of the magnitude of this shock which gives 10^{22} ergs as the lower limit of its energy.[4] In the case of the Quetta earthquake the lower limit was found to be 10^{21} ergs. Thus the energy of the Chilean earthquake, as manifested on the surface, was 10 times as great as that of the Quetta earthquake. Fortunately for the survivors, however, the former occurred at an abnormal depth. Had it been as shallow as the Quetta earthquake it would have produced much greater destruction which might have equalled that

[1] *Gerl. Beitr. Geophys.*, 1934, **43**, 82; *M.N.R.A.S., Geophys. Suppl.*, 1938, **4**, 370.
[2] *Nature*, 1939, **143**, 230
[3] *Publ. Bur. Centr. Seimol. Int.*, A, 14.
[4] *Gerl. Beitr. Geophys.*, 1936, **47**, 122–24.



Seismogram of the Chilean earthquake of January 25, 1939, recorded at Bombay
$\Delta = 144{\cdot}7$ Milne-Shaw, E.-W.

caused by some of the severest earthquakes of the world.

The E–W component of the seismogram of this earthquake as recorded at Bombay is reproduced above. The various phases that have been recognised have been marked on it. L_Q and L_R refer to Love and Rayleigh waves respectively. These have also been well recorded at most of the stations for which data are available.

On *Coeloplana* sp. discovered by Prof. W. M. Tattersall at Krusadai Island, Marine Biological Station, Gulf of Manaar*

By Dr. D. W. Devanesen, M.A., D.I.C., Ph.D. (Lond.)
and
Sri. S. Varadarajan, M.A.
(*Department of Fisheries, Madras*)

1. Introduction

THE genus *Cœloplana* was constituted by Kowalevsky, a Russian Naturalist, for a form he discovered in the Red Sea near the City of Tor in 1880, apparently because it combined cœlenterate and planarian characters. No less than nine species of *Cœloplana* have been recorded after the discovery of *Cœloplana metschnikowii*. They are:—

(1) *Cœloplana willeyi*, Abbot, 1901—Misaki, Japan.
(2) C. *mitsukurii*, Abbot, 1901—Misaki, Japan.
(3) C. *bocki*, Komai, 1920—Misaki, Japan.
(4) C. *gonactena*, Kremf, A. 1920—Coast of Annam.
(5) C. *astericola*, Th. Mortensen, 1927—Amboina and Kei Islands.
(6) C. *duboscqui*, Dawydoff, 1930—Gulf of Siam.
(7) C. *agniœ*, Dawydoff, 1930—Coast of Annam.
(8) C. *echinicola*, Tanaka, H. 1932—Japan.
(9) C. *bannwarthi*, Krumbach, Th. 1933—Gulf of Suez.

Prof. W. M. Tattersall, of the University College, Cardiff, Wales, delegate to the Silver Jubilee Session of the Indian Science Congress last year, visited the Krusadai Island Biological Station to study its fauna. On 7th February 1938, while examining certain sea-weeds, chiefly *Halimeda opuntia* collected from the Galaxea Reef lying to the east of Krusadai, he came across a specimen of *Cœloplana*. Unfortunately, he could not continue his observations as he had booked his passage and was due to leave for Colombo the next morning.

The work, therefore, of observing the habits and describing and identifying the Krusadai form was very kindly entrusted to us by the Professor and what facts we were able to collect within the short time at our disposal form the subject of this paper. The large number of species of *Cœloplana* recorded since 1880 made it impossible to settle the identity of the species to which the Krusadai *Cœloplanæ* belonged or to say definitely if they constituted a species new to science within the short time at our disposal.

As the sequel will show, it is likely that in our material—a dozen specimens†—is included more than one species of *Cœloplana*. For the present, therefore, we content ourselves with alluding to Krusadai *Cœloplanæ* in this paper rather than to particular Species.

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* Published with the permission of the Director of Fisheries, Madras.

† The one discovered by Prof. Tattersall broke to pieces when he attempted to kill it with cold corrosive.

2. Habitat and Habits

The locality where these animals live is a coral reef consisting mostly of dead corals within the tidal zone open to the action of the surf at high tide. If sea-weeds chiefly *Halimeda opuntia,* collected from the shallow streams caused by the receding sea at low tide when the reef is exposed, are left in a glass-dish with sea-water, one finds a few specimens on favourable occasions either creeping to the side of the glass or floating on the surface of the water. None has been collected from the plankton and it is therefore reasonable to conclude that these *Cœloplanæ* do not float in the sea, agreeing with other species in this respect. It is presumed that they normally adhere to or creep on the broad fronds of *Halimeda opuntia* in the natural state; but, in the laboratory, under artificial conditions, they float sometimes. Their powers of adhering must be of no mean order; for during the North-East Monsoon the sea in this area is one mass of roaring breakers and no living thing having anything short of strong roots can retain its foothold there. Our observation on one specimen from 20th June 1938 to 23rd June 1938 showed how the two extraordinarily long tentacles with their uniserial branches served the purpose practically of adherent roots. While tilting the cavity-slide to transfer the animal into a petri-dish, it threw out both the tentacles almost to their full length and spread out the branches on to the body of the slide like two parallel cables anchoring on by means of their branches (Fig. 1). The collablasts or adhesive cells on these tentacles doubtless will help the tentacular apparatus to stick to the substratum and defy dislodgement. These *Cœloplanæ* also adhered to the bottom of the petri-dish by means of their ventral surfaces alone; but, with what effect, can be gathered from the fact that a jet of water with a small pipette easily made them give up their hold. The reader should refer to Abbott's account for a graphic description of the locomotion of *Cœloplanæ* in captivity and of the movements of the tentacles in particular. The circular lip of the pouch in which each tentacle is contained is so mobile when the animal is active that one is reminded of a mouth rather than of the opening of a blind sac. The tentacles are paid out as a pair, or alternately, very slowly, now as a large bunch, now retracting, now again as a small bunch, as though the animal is testing the congeniality of the surroundings. One should, therefore, attribute a tactile function to these tentacles in addition to serving

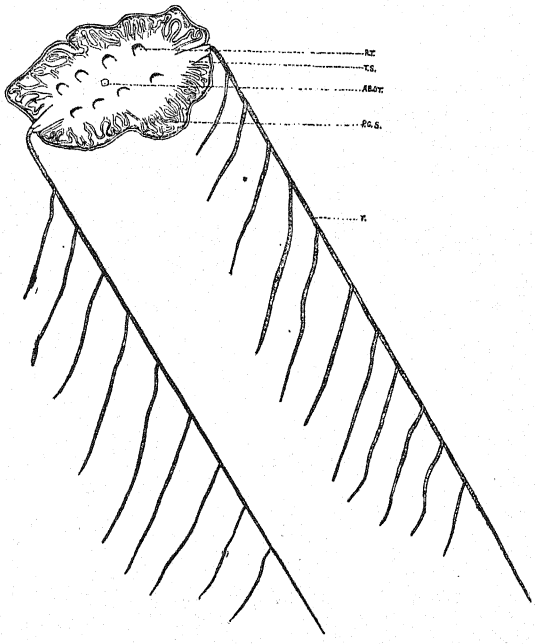

Fig. 1

Diagrammatic view showing the grey specimen of *Cœloplana* sp. putting out its tentacles like two cables and anchoring to the substratum with the help of its uniserial branches

AB.OT.–Aboral otolith; *T.*–Tentacle; *T.S.*–Tentacular sheath; *P.G.S.*–Peripheral portion of the Gastrovascular system ; *R.T.*–Respiratory tentacles.

as adhering structures. The tentacles are said to aid in the capture of prey but we have not yet had evidence of this nor have we conducted experiments on this yet.

We have not been able to determine the food of these *Cœloplanæ* except on one occasion when a squillid which was casually introduced into the petri-dish where a *Cœloplana* was lying with his body folded ventrally along the tentacular axis like a book was found to have got within the fatal embrace of the folds. There it was for about five minutes, showing its cephalothorax and trying to escape, but the *Cœloplana* held it firm mostly with the aid of colloblasts, we presume, and released it after, we presume again, it has sucked in its soft parts, for the squillid died soon afterwards.

3. External Characters

The respiratory tentacles are conspicuous structures rising from the aboral surface

varying from six to eight in number. They are either conical or blunt and knob-shaped and are arranged in two rows one on either side of the otolith and parallel to the tentacular axis. As the respiratory tentacles are known to be contractile, a conical tentacle may, if contracted, appear as a knob-shaped one and *vice versa;* but we have not seen these shapes interchanged in the same individual. The ciliation of the ventral surface has been noted by previous observers; while this ciliation was evident in most of the living specimens we examined, it was not descernible in one examined from 21st June 1938 to 23rd June 1938. This individual again was greyish in colour while the rest were olivaceous. As these animals are known to imitate the colour scheme of their surroundings, colour alone will be an insecure guide in determining specific values. Further study to settle this question of more than one species being included in the *Cœloplana* community off Krusadai is essential. The size of the animals varied from 3 mm. to 12 mm. in diameter.

The gastric canals are transparent and the circulation of food-particles can be watched not only in them in the living animals but in the respiratory tentacles as well, which form part of the gastro-vascular system. The Krusadai *Cœloplanæ* agree with other species in having no peripheral canal.

The tentacles, the virtual arms of the animal so to speak, have already been described in relation to habits. They show no deviation from the usual pair described hitherto by previous workers. The branches are uniserial and these are twisted into gnarls sometimes.

Attempts will be made to study the internal organisation and the embryology of Krusadai *Cœloplanæ* as time permits and opportunities occur.

4. Geographical Distribution

The species of *Cœloplana* hitherto described appear to be distributed in four zoogeographical regions as below:—

(*a*) Palæarctic Region—Japan.
Cœloplana willeyi,
C. mitsukurii,
C. bocki, and
C. echinicola.

(*b*) Ethiopian Region—Gulf of Suez and Red Sea.‡
Cœloplana metschnikowii and
C. bannwarthi.

(*c*) Oriental Region—Coast of Annam, Gulf of Siam and Gulf of Manaar.
Cœloplana gonactena,
C. aginæ,
C. duboscqui, and
the Krusadai *Cœloplanæ.*

(*d*) Australian Region—Amboina and Kei Islands between Celebes and New Guinea.
Cœloplana astericola.

Till now no species of *Cœloplana* have been recorded from the Nearctic Region, the Neotropical Region and the Polynesian Region.

5. Resumé

(1) The Krusadai *Cœloplanæ* are littoral in habit and are found in association with sea-weeds, chiefly *Halimeda opuntia.*

(2) The tentacles in addition to other functions may serve for the purpose of adhering firmly to the substratum as the area where they occur is subject to the action of the surf.

(3) The two different shapes of the respiratory tentacles and other characters touched upon may point to the occurrence of two species in the *Cœloplana* community off Krusadai. This is being investigated.

(4) The genus *Cœloplana* seems to be confined to the old world.

‡ This section borders on the Palæarctic Region.

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'Clean up' under Canal Ray Discharge

'CLEAN UP' in discharge tubes is a phenomenon that has often proved of interest, and is characterised by a sudden diminution of pressure, on initiating the discharge. The chief mechanisms[1] by which these are brought about are (1) through the agency of a "*getter*", (2) by the action of the electrical field in driving the ions bodily into the walls of the discharge tube and the metal electrode. It is conceivable that (1) and (2) may operate simultaneously and may, in fact, be mutually helpful. It is clear that (2) will be more prominent under conditions of the canal ray discharge on account of the higher operating voltages, etc. As the effect had a certain interest from the standpoint of another phenomenon, it was studied with picein[2] vapour as the "getter" with hydrogen as the gas in the discharge tube.

Since it was impossible to measure these rapid fluctuations in pressure by means of any elaborate measuring apparatus, attention was restricted to observing the fluctuations in the voltage, as measured by a sensitive H.T. voltmeter of the Kelvin-Whyte type, keeping the other electrical parameters, like the discharge current, the wattage input to the H.T. transformer, constant, during the course of the experiment. Under these conditions the voltage becomes a sufficiently accurate index of the pressure.

On the first addition of the getter to the discharge tube, the secondary voltage rose up rapidly as was to be expected, when it was tried to restore the pressure by allowing small amounts of hydrogen. At each such measure, the voltage fell down momentarily only to rise again to its high value, though the time rate of increase diminished after each addition. Finally, a stage was reached when the voltage after rising to its maximum, automatically fell down and showed signs of attaining a steady

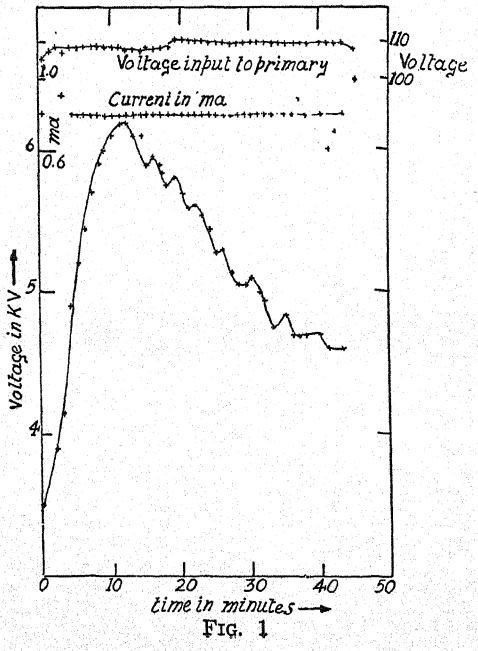

FIG. 1

value. This fall was characterised by a series of rapid fluctuations of small amplitude. In some experiments the same cycle of initial rise and subsequent fall was repeated. Significant changes in the colour of the discharge[3] accompany these fluctuations; in the absorption regime when the voltage is increasing, the colour of the discharge is that of hydrogen, during the regime of de-absorption, when the voltage is falling, there is a preponderance of the bluish white colour.

Figs. (1) and (2) show two typical curves giving these fluctuations as function of time. Observations showed that they were present even after a lapse of two hours, which is very remarkable. In Fig. (2) curves A, B, C show the changes after successive additions of hydrogen.

In view of the repetition of cyclic changes in some of the cases, the results cannot be explained in terms of breaking up of an initial

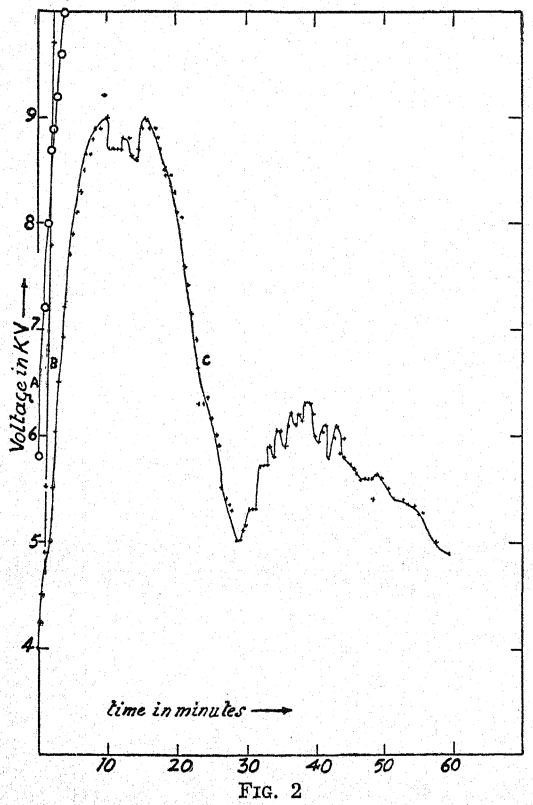

FIG. 2

layer on film by the subsequent effects of the discharge thermal or otherwise. One is led, therefore, to conclude that it is an instance of a periodic reaction (possibly adsorption). The pressures of the gas used in these experiments are of the order $10^{-2} - 10^{-3}$ cm. of mercury. The electrodes are both of aluminium.[4]

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College of Science,
Benares Hindu University,
February 23, 1939.

[1] Koller, L. R., *Physics of Electron Tubes*. (McGraw Hill), 1934, pp. 86–97.

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The Effect of Muscular Work on Protein Metabolism in the Ruminant

A review of the extensive literature on the effect of muscular work on the metabolism of proteins reveals the existence of two conflicting schools of thought, the one led by Mitchell, holding the view, that normally, and given a diet of sufficient calorigenic intake, increased protein metabolism is "not an inevitable consequence" of muscular work; and the other led by Cathcart, that work results in a definite, though often small, increase in nitrogen output, calling for an augmented protein intake to meet the extra needs.

Nearly all the available evidence on this subject has been obtained with experiments on humans. In the course of an investigation in this laboratory, on the protein requirements of working bullocks, it was noticed that muscular work resulted inevitably in a heightened catabolism of protein, reflected in an increased output of urinary nitrogen.

The experiments were conducted on four experimental animals, Bullocks of the Kangayam breed, well known for their hardiness and capacity for work, of as similar physical conditions as possible, with a live weight of 900–1,000 lbs. The ration fed consisted of Cholam (Sorghum) straw of uniform quality, and cotton seed as concentrate, throughout the long series of experiments. The roughage was

fed *ad lib.* all residues being measured to the nearest gram, the concentrate being adjusted by a preliminary run of nitrogen balance experiments to give a nitrogen equilibrium with the mixed ration fed, as determined by the balance sheet method. The muscular work performed was baling water at the Mhote for a measured number of hours, the number of buckets raised per hour being recorded by a hand-operated tally (45–50 buckets per hour), the lift being 20–25 feet for 40 gallon buckets. The nitrogen metabolism was studied for three 4-day intervals during continuous periods of work for 4, 6 and 8 hours of work.

From the results obtained for the nitrogen balance by determining intake and output in fæces and urine, linear regression equations were determined for the total nitrogen requirement at different levels of work, and their adequacy tested by the usual statistical methods. The results are given below:—

Equation (i) $y = 4{\cdot}79x + 46{\cdot}7$,

where y = Total nitrogen requirement (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE I

Fitted Regression

(Total nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	$(Y - y)$	$(Y - y)^2$
0	46	46·7	− 0·7	0·49
4	67	65·9	1·1	1·21
6	76	75·4	0·6	0·36
8	84	85·0	− 1·0	1·00

TABLE II

Analysis of Variance

(Total nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression	1	801	801
Deviation from linear regression	2	4	2
TOTAL ..	3	805	..

A similar equation was fitted for the nitrogen excretion in urine, as determined by analysis, representing the endogenous nitrogen metabolism of the animals. The results are given below:—

Equation (ii) $y = 2{\cdot}56x + 16{\cdot}6$,

where y = Endogenous nitrogen output (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE III

Fitted Regression

(Endogenous nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	$(Y - y)$	$(Y - y)^2$
0	17	16·6	0·4	0·16
4	26	26·8	− 0·8	0·64
6	33	32·0	1·0	1·00
8	37	37·1	− 0·1	0·01

TABLE IV

Analysis of Variance

(Endogenous nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression ..	1	229	229
Deviation from linear regression	2	2	1
TOTAL ..	3	231	..

From the results presented above, the following conclusions may be drawn:—

(i) Muscular work is necessarily followed by an increase in the metabolism of protein, as is shown by the need for increased protein in the diet to produce nitrogen equilibrium to meet the increased output of endogenous nitrogen.

(ii) The quantum of dietary protein required to produce nitrogen equilibrium at different levels of work is a linear function of the quantum of work performed.

(iii) The quantum of protein metabolised is also a linear function of the quantum of work performed.

(iv) The increment in dietary protein necessary to restore the animal to nitrogen equilibrium for each increment in work (about 5 grams for an increment in work of 2 hours) is small, and reckoned in terms of the energy liberated by the extra protein metabolised, is entirely inadequate to account for the energy required for the extra work performed. The significance of this small increase in the protein of the diet is, therefore, to be sought in causes other than inadequate calorie intake.

Studies of the nitrogen partition of the urine of the animals during the course of the work, showed that the major part of the increased output of endogenous nitrogen was in the form of Urea + Ammonia, indicating that the deaminisation phase of protein metabolism was the most active. Creatine occurred sporadically but in insignificant amounts. Creatinine excretion was very regular (2·5–3·0 gm. per diem) at all levels from rest to intense work, indicating that during muscular work even at high levels, tissue breakdown did not result in the excretion of creatine or creatinine; the metabolism of these compounds obeyed Folin's law, for rest as well as intense muscular work.

The coefficient of digestibility of the dietary nitrogen remained unchanged at all levels of work.

Full details of this investigation will be published elsewhere shortly.

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February 15, 1939.

Optical Activity of Lac

It is surprising that the optical rotatory power of lac has, so far, not been investigated; this is probably due to the circumstance that lac possesses a deep orange red colour. The colour of lac can be removed either by treatment with decolourising carbons or by bleaching with hypochlorite. Both treatments yield a product sufficiently colourless to enable an accurate determination of its optical activity.

An alcoholic solution of *Kusum* seed lac (10 per cent.) was treated with norit and filtered under suction over a bed of Kieselguhr. The clear but slightly yellow coloured solution which was thus obtained was employed for the determination of its optical activity.

The decolourised solution of lac was fractionated into (1) sclerolac and (2) soft lac by the addition of 10 volumes of ether to a given volume of the alcoholic solution of lac; the optical activity of the two lac fractions was determined in alcoholic solutions.

Analogous experiments were carried out with a sample of *Kusum* lac which was bleached by hypochlorite. Table I gives the results.

Table I

Specific Rotation $[\alpha]_D^{25°C}$.

	Lac decolourised by norit	Lac bleached by hypochlorite
Whole lac	+ 60·71	+ 59·29
Sclerolac fraction	+ 54·83	+ 51·26
Soft lac fraction	+ 63·60	+ 59·96

Further work on the isolation of the optically active constituents of the sclero- and the soft-fractions of lacs is in progress. The optical activity of lac is a property which should be of great value in studying the reactions of lac with ureas, fatty acids and other substances.

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Bangalore,
April 12, 1939.

The Thickness of the Surface Layer of the Soil Exchanging Moisture with the Adjacent Air Layers during the Clear Season at Poona

RECENT work[1,2,3,4,5,6,7] on the exchange of moisture between the soil and air layers near the surface of the ground has shown that during the clear season when the "surface layer" of the soil is so dry as to contain only hygroscopic moisture, the evaporation from the soil by day up to the maximum temperature epoch is compensated by re-absorption later of moisture from the adjacent air layers by the soil until the next morning. Further, it was shown that this exchange phenomenon is confined to the first inch or so of the soil, the diurnal variation of moisture at lower depths being negligible. The next question is what is the actual thickness of the "surface layer"? This engaged our attention during the current clear season. A brief report of the results obtained in the course of preliminary experiments is given below.

A series of brass cylinders, 4·75 cm. in diameter for exposing soil with depths ranging from 1 mm. to 40 mm. were made with their tops open and bottoms closed. Air-dry Poona soil passed through a 1 mm. sieve was filled in these vessels, the actual depths of soil being 1, 2, 3, 4, 5, 10, 20 and 40 mm. respectively. These were kept embedded in the ground with the top fully exposed to the atmosphere. The surface of the soil in the experimental vessels was at the same level as that of the soil outside. The experiment consisted of weighing the vessels at intervals to study the diurnal variations in the weights, *i.e.*, in the moisture contents of the soil samples. The table below is based on the observations made on the 23rd, 24th and 25th March 1939 and gives (1) the mean maximum weights of the soil samples (recorded in the morning), (2) the mean minimum weights of the samples (recorded in the afternoon about the maximum temperature epoch) and (3) the diurnal range of the moisture content, *i.e.*, (1) *minus* (2). At the bottom of the table, the relative humidity at the two epochs is also given.

TABLE I

Thickness of soil layer in millimetres	Mean *maximum* weight of soil in grammes	Mean *minimum* weight of soil in grammes	Difference between the mean maximum and minimum weight of the soil samples
1 mm. ..	2·720	2·454	0·266
2 ,, ..	5·936	5·608	0·328
3 ,, ..	7·645	7·173	0·472
4 ,, ..	11·102	10·524	0·578
5 ,, ..	13·152	12·464	0·688
10 , ..	26·951	26·170	0·781
20 ,, ..	54·288	53·574	0·714
40 , ..	102·950	102·254	0·696
Relative Humidity	51·3%	11·7%	Diurnal range = 39·6%

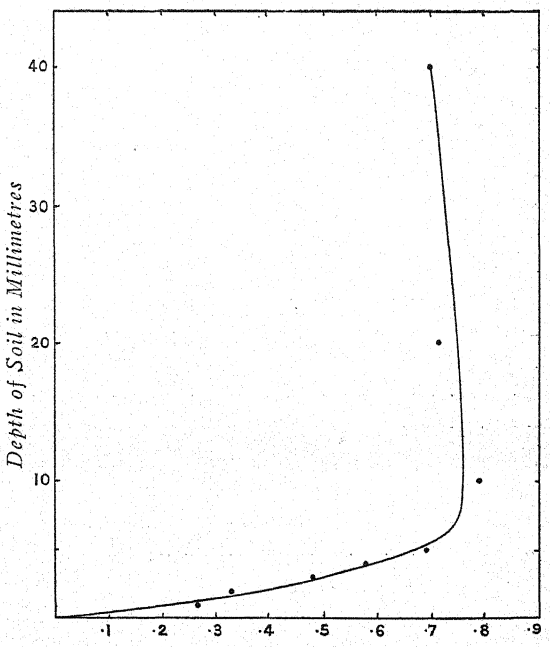

FIG. 1

The difference between the maximum weights and the minimum weights of the soil have been plotted against the thickness of the soil layer in Fig. 1. It will be seen that the difference in weight (this difference represents the weight of moisture lost by evaporation by the soil or gained by absorption from the atmosphere) increases with thickness up to about 10 mm., the variation being comparatively small thereafter, showing that the thickness of the "surface layer" of the soil which is affected by the diurnal exchange of moisture is of the order of a centimetre. The details of the experimental results will be discussed more fully elsewhere. Similar work with other typical soils of India is in progress.

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A. K. MALLIK.

India Meteorological Department,
April 6, 1939.
Poona,

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2 — and Katti, *Ind. Jour. Agri. Sci.*, 1934, **4**, 923.
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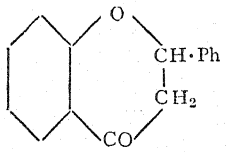
Rottlerin V

NARANG, RAY AND ROY[1] isolated a second colouring matter (pale yellow needles, m.p. 181°) from the benzene filtrates in the preparation of rottlerin from Kamala. This substance has now been more fully investigated. We have found that it can be easily separated from rottlerin if the crude colouring matter is crystallised from toluene. The toluene filtrates on concentration deposits a sticky mass which, on dissolution in ether and chromatographic adsorption on alumina, separates into six zones. The first, darker zone, is that of rottlerin, the second zone contains the substance m.p. 181° (Found: C, 69·95; H, 5·57%, $C_{31}H_{30}O_8$ requires C, 70·19; H, 5·66% and $C_{30}H_{28}O_8$ requires C, 69·76; H, 5·4%). The other zones are being investigated. The clear ethereal filtrate gives a colourless waxy substance.

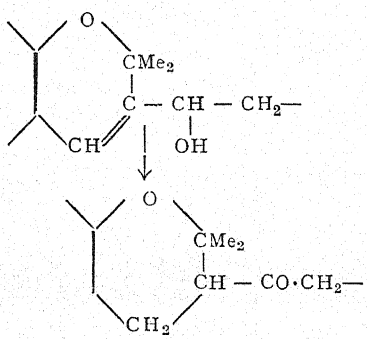
If rottlerin (5 g.) in 90% alcohol (250 c.c.) be heated with hydrochloric acid (15 c.c., density 1·14) for 7 hours (the solution becoming clear after 3½ hours) and then left overnight a solid deposit. The filtrate on dilution gave a pale yellow product which was crystallised from ether and found to be identical with the substance m.p. 181° isolated from natural sources. In later experiments the substance as obtained by dilution was purified by chromatographic adsorption on alumina. We have now come to the conclusion that this substance is identical with the substance m.p. 180° described by Brockmann and Maier[2] subsequent to our isolation of the substance in 1937. Brockmann and Maier have described it as a flavanone formed by the isomerisation of a hydroxy chalkone grouping in the rottlerin molecule. At first we were inclined to this view also, because the methyl ether of the substance (m.p. 135°–137°, not 105° as was wrongly reported[1] due to typographical error) gave a characteristic piperonylidine derivative (m.p. 145–147°, rectangular plates). Since rottlerin methyl ether did not give any condensation product with piperonal, therefore we thought that the easy formation of the piperonylidine derivative of this substance was due to the presence of $CO–CH_2$ group in *iso*-rottlerin. (We are adopting the nomenclature of Brockmann and Maier for this substance.) But the methyl ether of *iso*-rottlerin (Found: C, 71·64; H, 6·42; $C_{35}H_{38}O_8$ requires C, 71·67; H, 6·48; and $C_{36}H_{40}O_8$ requires C, 72·0 and H, 6·66%) prepared in a manner analogous to rottlerin methyl ether gave an oxide, with hydrogen peroxide similarly to rottlerin methyl ether. This substance (the oxide of *iso*-rottlerin) had m.p. 120–122° and gave C, 69·99 and H, 6·43% whilst $C_{35}H_{38}O_9$ requires C, 69·77; H, 6·3% and $C_{36}H_{40}O_9$ requires C, 70·01; H, 6·5%. On being heated just above its m.p. it evolved benzaldehyde copiously. Therefore, it seems

unlikely that the group $-CO\cdot CH=CH\cdot Ph$ is isomerised by the migration of a hydrogen from ortho-hydroxyl into



as has been supposed by Brockmann and Maier.[2]

The nitrosite of *iso*-rottlerin methyl ether had m.p. 194°–197° (decomp.) (Found: C, 63·36; H, 6·03). It seems that it is also formed exactly as in the case of rottlerin methyl ether by the addition of NO and NO_2 to one of the double bonds. We are engaged in reducing it by Pd and hydrogen and if any hydrogen is absorbed as it did in the case of rottlerin methyl ether nitrosite then the flavanone structure would be completely ruled out. In the meantime it may be observed that since *iso*-rottlerin methyl ether gives a piperonylidine derivative, and if the flavanone structure of *iso*-rottlerin is excluded and the $CH=CH\cdot Ph$ grouping is in tact in *iso*-rottlerin then the only other possibility is the saturation of the chromene double bond by isomerisation of a $CHOH-CH_2$-grouping to a $CO-CH_2$-grouping as indicated by the following partial formula



We have catalytically reduced *iso*-rottlerin. When the substance (2·0 g.) isolated by the elution of alumina was directly reduced, 230 c.c. of hydrogen was adsorbed at N.T.P. Two double bonds require about 180 c.c. But in this experiment we obtained two substances, one m.p. 209°, and the other, m.p. 225°–228° (decomp.). It seemed that there has been hydrogenolysis. The substance m.p. 209° gave C, 69·72, H, 6·02 ($C_{31}H_{32}O_8$ requires 69·92, H, 6·01 and $C_{31}H_{34}O_8$ requires C, 69·66; H, 6·3%). The substance m.p. 225°–228° gave C, 68·91 and H, 6·41, $(C_{11}H_{12}O_3)_n$ requires C, 68·7; H, 6·2%. In a second experiment, where *iso*-rottlerin purified by several crystallisations was employed for the reduction 2·0 gr. adsorbed 95·0 c.c. at 17°/746 mm. and the hydrogenated product m.p. 209° only was isolated, no trace of the higher melting substance being formed. But in this experiment a little *iso*-rottlerin could be detected as unreduced. Therefore we are not yet in a position to form any conclusions with regard to the number of double bonds in the molecule.

Further experiments are in progress and the details will be published elsewhere later on.

(The late) HARBANS SINGH BAKSHI.
RAVI S. JALOTA.
K. S. NARANG.
J. N. RAY.

The University,
Lahore,
April 6, 1939.

[1] *J.C.S.*, 1937, 1863.
[2] *Annalen*, 1938, **535**, 170.

On the Occurrence of an Eocene Bed in the Pondicherry Cretaceous Area, S. India

IN the course of a recent examination of some of the rocks from the Pondicherry Cretaceous area, I find that one of the limestones contains a foraminiferal fauna of extraordinary interest, which definitely indicates a lower Eocene age. Sections of this limestone are seen to be crowded with *Discocyclina* (Fig. 1), and what is perhaps even more important and valuable is that, in addition to this, we have also plenty of *Nummulites* [*Camerina*]. The discovery of such a striking association of *Discocyclina* and *Nummulites* in a limestone coming from an area

which has hitherto been considered as composed exclusively of Cretaceous rocks naturally arrested my attention, and on further study, it

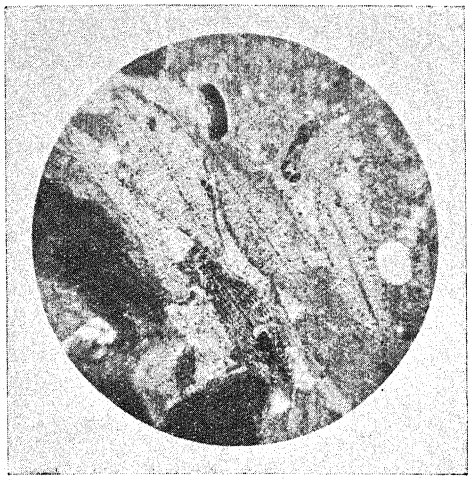


FIG. 1

was obvious that here we have the occurrence of a bed with a foraminiferal fauna comparable in certain respects with that of the Paleocene beds of N.W. India. In making sure of this point, I have had the valuable collaboration of my friend Mr. Y. Nagappa, Assistant Palæontologist, of the Burmah Oil Co., who very kindly undertook to examine these foraminifers in greater detail and also compare them with the types described from the Eocene beds of N.W. India. As a result of this work, it is clear that these Pondicherry foraminifers are very similar to, and in some cases (as for instance, certain species of *Discocyclina* and *Cibicides*) identical with those recorded from the Ranikot stage in N.W. India. Thus it would appear that the marine transgression during the later part of the Cretaceous period, which gave rise to the upper Cretaceous beds of this area, lingered on even into Paleocene times.

This discovery, on the east coast of India, of a lower Eocene bed, with a similarity in its foraminiferal fauna to contemporaneous beds in N.W. India, is evidently of far-reaching significance and importance; and this will be discussed in a more detailed paper to be published in due course.

My best thanks are due to Mr. Y. Nagappa for his valuable assistance in the study of these foraminifers, and to Mr. C. A. Sansom, Chief Geologist of the B.O.C., Burma, for giving Mr. Nagappa the necessary permission and facilities for doing this work in the Company's excellent Palæontological Museum at Khodaung, and for permitting me to publish these results.

L. RAMA RAO.

University of Mysore,
Department of Geology,
Central College, Bangalore,
April 5, 1939.

Lepidocyclina from the Agate Conglomerates near Surat and Broach (Western India)

THE agate conglomerates between Surat and Broach occupy a large tract of the country and often attain considerable thickness. They are frequently associated with ferruginous sandstones which contain small agates and rounded trap pebbles. All these beds are fossiliferous and occur as outliers surrounded by the Eocene Nummulitic beds. In several sections on the banks of the Tapti, near Tarkeshwar and Kimamlee, they are found resting on the Nummulitic series. In a collection of fossils I recently made from the conglomerates and the associated sandstones, I have noticed the presence of foraminifera of the important genus *Lepidocyclina* which, as is well known, is confined to the Oligocene (Nari) and Miocene (Gaj) beds of the Indian region and elsewhere.[1] The *Lepidocyclina* noticed in these beds are small forms and are represented by two species which are different from those hitherto recorded from India.[2] One of these, *L.* (*Lepidocyclina*) sp. nov. [Fig. (*a*) & (*b*)] shows some resemblance to *L.* (*Lepidocylina*) *canellei* Lemoine and R. Douville. The microspheric and megalospheric generations are both represented in my collections. The other species is *L.* (*Nephrolepidina*) *sumatrensis* Brady var. nov. [Fig. (*c*) & (*d*)]. The affinity to the type

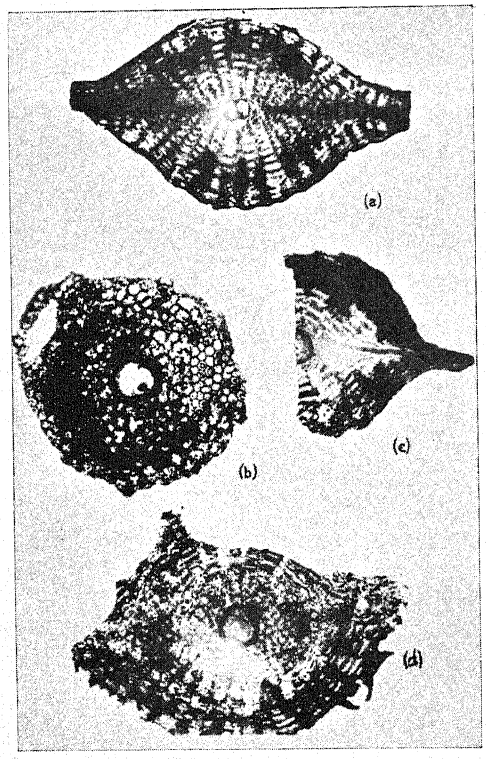


FIG. 1

(*a*) Meridian section, and (*b*) Equatorial section of *L.* (*Lepidocyclina*) sp. nov. (A.-form). × 25. Loc.—Kimamlee, near Surat. (*c*) Meridian section, and (*d*) Equatorial section of *L.* (*Nephrolepidina*) *sumatrensis*, Brady, var.nov. (A.-form). × 25. Loc.—same as above.

species from Sumatra is very marked and the differences are only of a varietal degree. Prof. H. Douville,[3] in his scheme of classification for the Far-East, has noted that small *Nephrolepidina* of the type represented by the species *sumatrensis* as characteristic of the Burdigalian stage. The agate conglomerates and the associated sandstones may, therefore, be assigned to the corresponding Indian stage in the Gaj series.

S. R. NARAYANA RAO.

Department of Geology,
University of Mysore,
April 5, 1939.

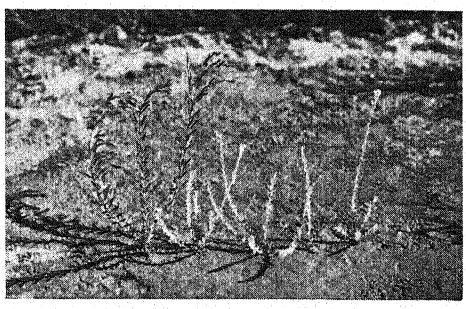
[1] Lt.-Col. L. M. Davies has recently described *L.* (*Polylepidina*) *punjabensis* Davies, from the Ranikot (Paleocene) beds of the Punjab Salt Range (*Pal. Ind.*, n.s., 1937, **24**). This appears to be a very unusual occurrence. According to Vaughan (*Biogeographic Relations of the Orbitoid Foraminifera*, 1933), *Lepidocyclina* and its allies appear to have originated in America during middle and upper Eocene time and migrated from there to other parts of the world. Vredenburg and Nuttall both regard this genus as confined to the Oligocene and Miocene of Indian beds.

[3] Nuttall, W. L. F., *Ann. Mag. Nat. Hist.*, 1926, **17**, 330–37.

[3] Douville, H., *Mem. Geol. Soc. Fr.*, 1925, **Mem. 2**, 84.

A Note on the Occurrence of a Chlorophyll Deficiency in Linseed (*Linum usitatissimum* L.)

A CHLOROPHYLL deficient plant was observed in the Botanical Section at Pusa in a field of the linseed variety, Pusa Type 12 (Howard and Khan),[1] in 1933–34. This plant was quite distinct from the surrounding plants, the terminal portions of all its branches being yellow and the lower parts containing only a small amount of chlorophyll making these portions look greenish yellow (Fig. 1). As in



Left: Normal green plant of Type 12.
Right: Mutant plants.

Type 12, the flowers were pale blue and did not open fully. The plant was stunted and produced very few seeds. In the following year it bred true for the chlorophyll deficient character. The cotyledonary leaves of the seedlings were normal green, but the chlorophyll deficiency was visible from the first pair of true leaves, the growing points of the seedlings showing the characteristic yellow colour. The original plant

appears to have arisen as a mutant from Type 12.

In F_3, fifteen cultures were grown in 1937–38. They behaved as follows:—

Cultures	2	3	6	7 A	8A	18 B	26 B	28	29
Heterozygous—									
Green	46	35	19	17	15	23	15	29	25
Chlorophyll deficient ..	8	9	8	5	5	6	5	4	4
TOTAL ..	54	44	27	22	20	29	20	33	29
X^2 (3 : 1)	3·19	0·48	0·31	0·05	0·00	0·29	0·00	2·92	1·95

Cultures	11	13 A	17	24	25	30
Homozygous—						
Green	46	37	48	..	..	..
Chlorophyll deficient ..	..	..	..	12	18	22

Chlorophyll deficiency in *Linum* has been reported by Fischbach.[2] He observed variegated plants in the F_1 of *Linum hirsutum* × *L. viscosum*, although both the parents were normal green.

The new mutant type was crossed with Type 12 (T. 12 $\times$ Mutant) in 1934–35 and in 1935–36 the F_1 was grown. The F_1 plants were normal green like the Type 12 parent and could not be distinguished from it except by their hybrid vigour, being more vigorous in growth and slightly earlier in maturity than either parent. The green condition, therefore, is completely dominant to the chlorophyll deficient condition.

The F_2 progeny was grown in 1936–37 and the results given below were obtained:—

	Green	Chlorophyll deficient	Total
Observed	368	100	468
Expected on 3 : 1 basis	351	117	468

$X^2 = 3·29$ and P is between 0·1 and 0·05; the fit is fair.

In all the above segregating cultures there is agreement between the observed and the expected frequencies and the ratio of homozygous to heterozygous cultures in F_3 also approximates to expectation. The results, therefore, clearly indicate a single factor difference between the normal and the chlorophyll deficient conditions.

It may, however, be pointed out that in F_2 and in the majority of F_3 cultures there is a deficiency in the chlorophyll deficient class. This may be due to the death of some of the chlorophyll deficient plants, which, being very weak, could not grow as well as the normal plants. Dead plants which seemed to belong to this class were actually observed while taking the counts, but were not taken into consideration.

R. B. DESHPANDE.

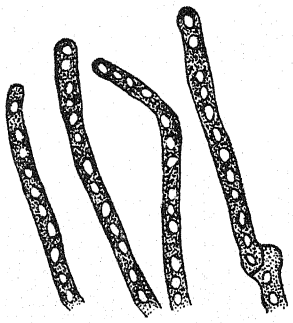
Imperial Agricultural Research Institute,
New Delhi,
April 3, 1939.

[1] Howard, G. L. C., and Khan, A. R., *Mem. Dept. Agric. India* (Bot. Ser.), 1924, **12**, 1.

[2] Fischbach, C., *Z. indukt. Abstamm. U. Vererb. Lehre*, 1933, **65**, 180.

Pinkish Vacuolar Stain in Growing Tips of Fungal Hyphæ in Artificial Culture

In the course of my work on artificial cultures of *Polypores* I have found a pinkish stain (a very light tint—"Hermosa pink" of Ridgway—visible only after very careful examination under the oil-immersion lens) in the vacuoles of the growing tips as well as a little older portions of all hyphæ (Fig. 1); it is found not



Polystictus sanguineus in culture, Young hyphæ (one with clamp) showing vacuoles which are coloured pinkish (Camera lucida-sketch under oil immersion lens 2 mm. and eye-piece No. 5)

only in cases of coloured species (*i.e., Polyporus rubidus, Polystictus sanguineus, Polystictus versicolor, Trametes persooni, Dœdalea flavida,* etc.) but in perfectly white species like *Polyporus ostreiformis.* Subsequently, extending my observations I found almost the same stain in diverse groups of fungi like *Mucor, Yeast, Aspergillus, Penicillium, Beauvaria, Ascoidea rubescens,* etc. The stain becomes fainter in very old hyphæ and is not found in dead double-walled hyphæ or hyphæ undergoing fatty degeneration. Brownian movement was noticed in some of the vacuoles which are generally of varying dimensions. The vacuoles were all naturally coloured pinkish, the pigment evidently being in a state of solution. Gulliermond[1] recorded that in the meristem of a higher plant (very young root of *Ricinus*) all the vacuoles are naturally coloured red without the use of any artificial vital-colouring agent like the neutral red, due to the presence of anthocyanin pigment. He has figured such vacuoles. The nature of the pigment is, however, quite unknown here; the pigments in fungi are so different from those in higher plants that it becomes difficult to describe them by any known term.

Kögl[2] while recently summarising our knowledge about pigments in fungi has indicated how little is known about them with certainty; in very few cases he could supply the definite chemical composition of the pigment. And in all these cases the pigments that have been described, are deposited on the walls of dead hyphæ giving rise to the prevailing naked eye-colour of the outer surface of the sporophores. The pigments in vacuoles of living hyphæ have not been dealt with so far. In the present state of our knowledge, though we cannot go further, I think it may be safely put forward that this stain has some connection with the metabolic stage of the fungus as being found only in actively growing hyphæ and becoming scarce in very old and dead hyphæ and in older cultures.

The pinkish stain of the vacuoles is insoluble in petrol-ether, ether, chloroform, alcohol (higher and lower grades), in hot and cold water and has no apparent connection with light, it can develop in the dark as well. It is also insoluble in weak acids and alkalies; with 8 to 10% caustic potash the pinkish stain becomes much fainter with the contraction of vacuoles, it turns greenish, in some cases whitish; with 10% acetic acid the majority of the vacuoles turns greenish or whitish though a few still retain the original pinkish colour. With H_2O_2 it does not turn yellowish. Thus, the chemical tests so far do not lend support to its belonging to the group of anthocyanins as found in higher plants. I shall be glad to have the experience of other workers on the point.

Any kind of chemical analysis (whether micro- or macro-) of the pigment in such vacuoles seems impossible with such a small

quantity, nor any absorption-spectrum could be obtained.

S. R. Bose.

Botanical Laboratory,
Carmichael Medical College,
Calcutta,
April 1, 1939.

[1] Gulliermond, A., and others, *Traité de Cytologie Végétale*, Paris, 1933, 302–3.

[2] Kögl, F., Pilzfarbstoffe in G. Klein's *Handbuch der Pflanzenanalyse*, Wien, 1932, **Band III/2**, 1411–36.

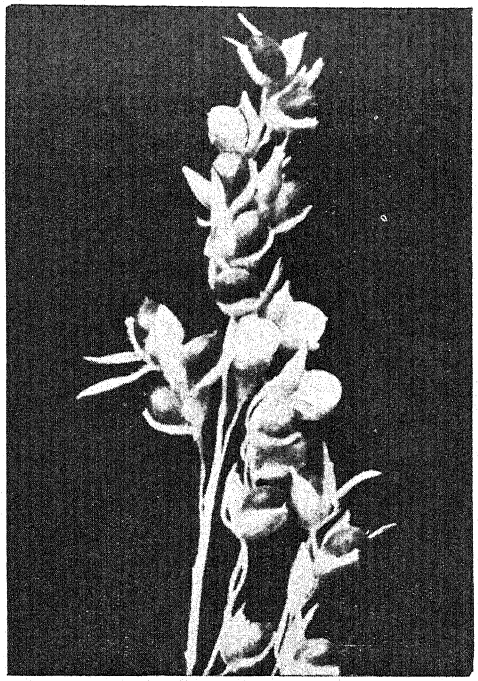
Recurrent Pseudo-Mutations in Sorghum

Mutations are of frequent occurrence in the plant world. When these occur there is a sudden change in the genic constitution affecting the progeny. Instances of mutations that occur without conforming to this simple nature are on record. In some of these cases the mutations occur late in the development of the seed so that the embryo remains unaffected. The mutation affects parts of the seed other than the embryo.

These rare phenomena have therefore been called *pseudo-mutations*. *Recurrent* pseudo-mutations are rarer still. Imai (1935)[1] records two instances one each in the seed coat of *Phaseolus vulgaris* and *Pisum sativum*. The occurrence of recurrent pseudo-mutations in the seed coat colour and nucellus colour of sorghum grains is recorded below.

Pericarp Brown.—In the year 1926 in family number A.S.1349, which segregated for brown and white grains, one brown grained earhead with a few white grains on it was noticed (see illustration). The seed from this earhead was sown in 1927 (A.S.1958). It gave a simple monohybrid segregation for brown and white grained earheads. In the 62 brown grained earheads, there were 4 with stray white grains, a repetition of the 1926 experience. In these four earheads the number of white grains were 3, 4, 4 and 14.

In 1933 a similar experience occurred in family A.S.3277 segregating in a 9:7 ratio of



Stray white grains occurring among brown grains in sorghum through pseudo-mutation

brown and white grains. In one out of 128 brown grained earheads, this experience was observed, the number of white grains being 14. This earhead was sown (A.S.4784) and its progeny segregated for brown and white grains. In the brown grain population of 176, this phenomenon was repeated in 3 earheads, one of them giving as many as 21 white grains. It should be mentioned that the 14 white grains separated from the brown grained earhead were sown separately. From these, 7 plants grew to maturity, and of these, 5 were brown grained and 2 white grained. None of the 5 brown grained earheads exhibited this phenomenon of pseudo-mutation. The mutating tendency was in the family and was not perpetuated preferentially through the actual grain which is the resultant thereof.

These pseudo-mutations recurred in the third year also. The earhead in which 21 grains were white was sown (A.S.5518) and in the progeny, consisting of 234 brown grained and 81 white-grained earheads, there were 3 earheads in which the phenomenon recurred. In

the progeny from three other sister heads without evidence of pseudo-mutation, this phenomenon occurred in 14 earheads. In one of these the number of white grains was 30.

Similar experiences were met with in two other cases. In one of these cases the earhead that mutated did not repeat the behaviour but some of the all-brown grained sister heads exhibited the mutating phenomenon. In all the above families the progeny segregated for brown and white grains. The plants which mutated were very few (1 to 8 in a population of about 200 brown-grained plants), and the number of grains in each earhead was also very few (1 to 30 in a total of 2,000 to 4,000 grains per earhead). The most noteworthy point in this experience is that the pseudo-white grains separated and sown gave both brown and white grained plants, similar to the progeny from the brown grains in the earhead.

Nucellar Brown.—Pseudo-mutations also occurred in earheads in which the grains have their nucellus coloured brown. In such earheads odd grains with no colour in the nucellus occurred. These grains stand out less prominently from the mass of nucellus coloured grains than in the previous instance, where the white grains are in marked contrast to the mass of grains with brown pericarp. In family A.S.4930, that segregated for brown coloured nucellus to no colour in the nucellus, there occurred one earhead in which 49 grains were without colour, while in the rest of the grains (1040) the nucellus was coloured brown. This earhead was sown with the grains separated. The progeny from seeds with coloured nucellus, segregated for nucellar colour. In these 11 earheads with coloured nucellus repeated the parental pseudo-mutation experience. From 24 white grains sown, only 6 plants grew to maturity, and 5 of these gave earheads with nucellus coloured brown and one without colour; of the 5, three earheads mutated. In one of these earheads, almost a sixth of the number of grains had no colour in the nucellus.

There are evidences of reversibility of these pseudo-mutations; also the possibility of their constancy in occurrence. These aspects are under study.

G. N. Rangaswami Ayyangar.
M. A. Sankara Ayyar.
A. Kunhikoran Nambiar.

Millets Breeding Station,
Agricultural Research Institute,
Coimbatore,
March 25, 1939.

[1] *American Naturalist*, 1935, **69**, 456–59.

Excitability and Responsiveness

The confirmation from Annamalai[1] of the new views on the Physiology of Vision which originated in Lucknow have a natural interest for me. In connection with them I would point out that Dr. Naidu started from an advantageous position in the form of the open mind. In contrast with this the various authorities whom he quotes have started out with a firm faith that the phenomena ought to have their explanation in terms of the actions of electric currents on isolated muscle or nerve.

A further discovery from Lucknow is that all who have so far dealt with these and kindred matters have been bemused by the seeming comprehensiveness of one of our fundamental definitions, *viz.*, that of excitability. Fredericq recently defined this as the property which a living tissue possesses of answering by a change in shape, state, or position to a modification occurring in the surrounding medium. This definition is a wide one and covers the excitation of an isolated muscle or nerve by electric currents, the stimulation of beating hearts by drugs, and our own reactions—*e.g.*, to start at the sound of a motor horn—to our environment. Hence, the reasonable inference that all these reactions to environment are mediated by the common possession of excitability.

All physiologists save myself have made exact studies of this excitability by electrical methods. I started its investigation by stimulating beating hearts with drugs, but, after regularly obtaining thereby results always at variance with those obtained by electrical

methods, I could but conclude that I was investigating something else. I could not have been so doing if the definition of excitability given above had that validity so far accorded to it, but the facts were there to prove the difference. Accordingly I have called the property, responsiveness, which I found myself investigating, and left excitability to designate the property investigated through electric currents.

The difference between these two properties can be made clear through motor cars. The excitability of a motor car is definable as the capacity of the gases in its cylinders to explode under the influence of the electric spark. In contrast with this, its responsiveness is its capacity to have its activity varied through feeding the cylinders with different mixtures from the carburettor.

Living tissues in the body are in a condition comparable with that of a motor which just ticks over, and their natural stimulation is effected by a process akin to that of altering the setting of a carburettor. A living carburettor, however, has so far had no existence in our philosophy. The gap was bridged by hypotheses whose nature may also be grasped through the motor car. All of us believed, and some of us still believe, that the accelerator pedal is directly connected with the sparking mechanism and that changes in the explosions follow on alterations in the sparking mechanism. In effect, controversy still goes on between a school of thought that believes that pressure on the accelerator pedal improves explosions through making the spark long and thin, and a school that believes the spark becomes short and fat. Both schools carefully examine evidence concerning the thinness and fatness of sparks, and believe that it is not nice to know or mention such things as carburettors.

If these Lucknow views were correct prediction would be possible. Things are so, and I conclude with two examples given below.

The confirmations were done without knowledge of the existence of the predictions. Hence there can be no doubt that Prof. Adrian's findings were not biased by preconceived notions. And in matters physiological prediction was never previously possible.

W. Burridge.

Department of Physiology,
King George's Medical College,
Lucknow,
March 16, 1939.

[1] *Curr. Sci.*, 1938, **7**, 273.

Deductions	Confirmations
Burridge.—A New Physiological Psychology, Arnold, London, 1934.	*Adrian.—Proc. Roy. Soc. Med.*, 1936, **29**, 197.
P. 43.—The picture thus presented of an organ of mind shows it as consisting of a vast complex of discrete groupings of neurones, each group dancing to its own tune with its own strength.	The cortex need not be regarded as a system of several million independent units. The cells act in groups, small or large.
P. 54.—....there exists an integrative tendency which determines that groups of neighbouring yet isolated neurones must seek a common rhythm and a resultant.	Nerve cells are rarely at rest, but tend to discharge periodically, though there may be no afferent excitations to arouse them.
	Group of nerve cells tend to act in unison when there is nothing to prevent them. These co-ordinated waves of activity express the tendency of nerve cells to associate together.

REVIEWS

Cattle Fodder and Human Nutrition. By Artturi, I. Virtanen. (Cambridge University Press, London), 1938. Price 7/6 net.

In a series of four informative and stimulating lectures delivered at the Universities of London and Reading, Professor Virtanen develops the theme that the biological fixation of nitrogen constitutes the fundamental basis on which rests the production of milk. Leguminous crops which derive their nitrogen from the atmosphere, through the agency of symbiotic bacteria, provide cattle with protein-rich nutriment thereby enabling them to yield milk. The culture of legumes has another important function; to enrich the soil by excreting nitrogenous materials which are utilised by the associated non-leguminous plants. Professor Virtanen has thrown new light on the mechanism of the biological fixation of nitrogen which forms the subject-matter of his first lecture which the reviewer had the pleasure of listening to at Cambridge. He has established the scientific rationale of an ancient, time-honoured and widely prevalent practice of raising cereals and legumes as a mixed crop.

In northern countries which are faced with long winters, the problem of milk production is one of vital importance. The cows have to be stall-fed during the greater part of the year and the question of providing them with a protein- and vitamin-rich fodder is one which has received the close attention of Prof. Virtanen and his co-workers. The A.I.V. process discovered by them has solved the fodder problem; this has enabled the Finnish farmers to produce in the winter months, milk of a quality and a vitaminic potency which is equivalent to that produced in summer. This is an achievement of which Prof. Virtanen may well be proud.

In India, the quality of milk with respect to its protein, fat and vitamin content, varies widely. In summer months, the problem of fodder is acute; Professor Virtanen's process of preserving fodder deserves to be widely investigated to suit local conditions.

The volume is one of topical interest, raising as it does the problem of human nutrition. It is a book which should be widely read not only by investigators but also by administrators who are interested in planning a sound policy of national nutrition.

M. S.

The Basic Mechanics of Human Vision. By R. Brook Simpkins. (Chapman & Hall, Ltd., London), 1939. Pp. 228. Price 12/6.

This is an interesting book whose author takes the view that accommodation of the eye is brought about by an elongation of its axis effected through its extrinsic muscles. In this he admittedly follows Von Arlt, and brings to the aid of the hypothesis a wealth of mechanical data. The reviewer believes, however, that the author has not sufficiently studied the evidence of fact evinced by Sansom's or Purkinge's images. Their observation demonstrates that the only structure which can be seen to change during accommodation is the anterior surface of the lens, is posterior surface and the cornea remaining fixed. Hence, admitting for argument that there is an elongation, it must be the posterior part of the eyeball that moves. If such were the case, Purkinge's figures should change position on accommodation, but the reviewer failed to find evidence of this. On the whole, then, the reviewer believes that accommodation in man is effected differently from that in certain fishes.

It is evident from the book that the author has not undergone any medical training. For, had he done so, he would have been more chary of introducing theories of plus, static and minus innervation of muscles. What the author is trying to get at here is apparent to a medical man, but the latter would not describe the phenomena as is here done.

An absence of medical training also deprives the author of the opportunity to discuss those very interesting drugs, atropine and pilocarpine. The intrinsic and extrinsic muscles belong to two different classes of muscles which react differently to the actions of drugs, electrical stimulation, *et hoc genus omne*. It would be a most extraordinary phenomenon if atropine acted on the extrinsic muscles, and an equally extraordinary phenomenon if atropine acted on the

intrinsic ones. There is, moreover, a wealth of experimental evidence which demonstrates that the atropine and pilocarpine act only on the intrinsic muscles of the eye. Since also there is no doubt of the ability of atropine to paralyse accommodation, it should be accepted that the muscle which atropine paralyses, the ciliary muscle, is the one concerned in accommodation.

As regards the instruments invented by the author for eye exercises, the reviewer may first be permitted to express a dislike for their hybrid names. But, putting that aside, while there is adequate evidence concerning the manner in which the instruments are intended to be used, there is a deplorable lack of evidence concerning their usefulness. An Appendix giving, say, a series of 200 cases with their original conditions, the nature and duration of the treatments and the results, would remedy this defect. The reviewer is quite prepared to believe that a mode of treatment based on erroneous hypotheses may yet be beneficial.

W. BURRIDGE.

The Evolution of Genetic Systems. By C. D. Darlington. (Cambridge University Press, London), 1939. Pp. 149, text-figs. 26. Price 10/6 net.

The title of this book was the title of the last chapter in the first edition of Dr. Darlington's text-book *Recent Advances in Cytology*. That chapter was omitted from the second edition. It has now been expanded and the cytological facts which account for the phenomena of genetics are simply and concisely expounded in a handy volume.

This is a lucid and readable resumé of much that is set forth in the author's longer work, set down briefly and unhampered by exhaustive series of examples and references.

Genetics is concerned with reproduction. This book contains a clear account of the behaviour and evolution of the visible determinants of heredity in the cell nucleus, *i.e.*, the chromosomes. There are concise descriptions of meiosis, chromosome mechanics and the mechanism of genetic crossing-over according to the latest discoveries and system of nomenclature. The evolution of polyploidy, of differential chromosomal complements by structural changes, of permanent hybrids, of sex inheritance, of sterility and apomixis are traced. The penultimate chapter deals with the manner in which the units of heredity, the genes, act upon the nucleus, cytoplasm and body as a whole. The final chapter surveys the evolution of reproductive systems from the naked gene and also the broader implications with reference to the evolution of species and to the classical theories of Lamarck and Darwin.

There is a bibliography of ninety-one titles and an excellent index. This little book by the world's foremost cytologist will be welcomed by everyone interested in the mechanism of heredity; not only cytologists and geneticists but teachers, medical men, professional breeders and all members of the public who wish for reliable, up-to-the-minute information on modern "natural philosophy".

EILEEN W. ERLANSON.

Cotton Breeding and Seed Supply. (Published by the International Institute of Agriculture, Rome), 1938. Pp. 71. Price 15 lire, post free.

This is a companion volume to the monograph on *World Cotton Production and Trade* published by the above Institute in 1936. It is, as stated by the Secretary-General of the Institute, compiled from information given in books, reviews and from answers furnished to a questionnaire, by institutions and workers engaged in cotton research.

Although breeding in cotton has been practised for a long time in a number of countries both by private breeders as well as by staff employed in Government instiitions, there are few publications giving a connected account of the methods adopted and of the results obtained therein. This volume will, therefore, be welcomed by all cotton workers as one supplying a long-felt want.

The first chapter is devoted to the description of the objectives in cotton breeding where, rightly enough, prominence is given to improvement of yield; and valuable information is supplied under the improvement of quality. It is felt, however, that sufficient stress has not been laid on the interrelation between quantity and quality and on their combined effect on the economics of the grower. The presentation of Harland's schematic analysis of yield and the statement that "selection work has to reckon with all those characters when looking out for mother plants" leave an impression that isolation of types possessing such

characters will automatically result in increased yields. But actually it is well known amongst all cotton breeders that it is only the final weight of lint obtained per unit area that counts, owing to many unknown physiological limitations set up in the plant during growth. For instance, increase in the number of locks per boll results in a reduction of the number of seeds per lock which, in its turn, affects the weight of individual seeds, although all these form components of yield according to Harland's scheme.

In the next chapter, the classification of the cotton varieties is dealt with. The grouping adopted by Harland has been reproduced in detail; but the nomenclature used by Watt, Gammie, Hutchinson and Ghose has also been used in addition, which will cause some confusion in the minds of the casual reader in the identification of cottons referred to in the monograph.

The third chapter describes the breeding methods. It is refreshing to note that emphasis has correctly been laid on the importance of acclimatisation and also on the causes that lead to failures. One wishes, however, that information given under selection is made more complete and up-to-date. Undue importance is given to the method of type selection which is now being superseded by methods which will enable to distinguish genetic variance from that caused by environment. The main objectives in breeding, *viz.*, yield and quality, being quantitative in performance, description of methods useful in the evolution of stability in such characters will prove profitable to the workers. It is now recognised that methods like the replicated family block method, dealt by Hutchinson and Panse, will reduce much of the personal element generally associated with the type selection method.

The chapter on propagation and conservation of cotton varieties gives a complete and lucid picture of the steps taken in Egypt and U.S.A. to maintain pure seed supply and will, therefore, prove very instructive to all interested in cotton improvement. This is followed by an interesting contribution on the trends of improvement in the chief cotton-growing countries of the world. Too much space is, however, devoted to the enumeration of the various commercial varieties found in India which is not completely relevant to indicate the trend of improvement.

A fairly good list of literature is appended at the end, although a few recent publications like those on plant breeding technique by J. B. Hutchinson and his collaborators, are being missed.

On the whole, this booklet will form a useful addition to the list of references on cotton breeding. V. R.

A Text-Book of Thermodynamics. By F. E. Hoare. II Edition. (Edward Arnold & Co., London), 1938. Pp. 307 + xii. Price 15*sh.*

"There appear to be, however, few books showing the variety of subjects to which thermodynamics can be applied, and it was in the hope of remedying this deficiency that this book was written." In the second edition, certain portions of the book have been revised; the notation has been altered in accordance with the recommendations made by the Joint Committee of the Chemical, Faraday and Physical Societies; a collection of examples with answers has been added. These changes have considerably enhanced the usefulness of the book. Exposition is generally clear. One exception, however, is to be found in the treatment of ionic migration (p. 207) which has been discussed without introducing the term "transference number". An introduction to non-ideal solutions with a brief discussion of the modern views regarding strong electrolytes would have been highly useful. Notwithstanding these minor shortcomings, the book serves well as a general introductory treatise on thermodynamics, especially to the physics students. K. S. G. D.

Problems of Power Supply in India. Symposium held under the auspices of the National Academy of Sciences, India. (*Proc. National Academy of Sciences, Special Number*), 1938. Pp. 100. Price Rs. 2 (India), Rs. 2/8 (Foreign).

The desire for self-determination in India has coincided with intense ferment in the minds of the intelligentsia in various directions. No nation can achieve and maintain its freedom without being strong in the sciences of the day—agriculture, industry and defence. In a word, power is the *sine qua non* of Indian freedom. The National Academy of Sciences has drawn attention to

the need of properly harnessing our electrical power resources in its illustrated booklet.

Lenin wrote, in 1920, "without electrification, progress in industry is impossible" and directed two hundred scientists and engineers to plan the restoration of Russian national economy. G. R. Toshniwal describes how this Goelro-plan, in ten years, reconstructed industry with the result that "the Russians are no longer a half-clad and starved nation". Prof. M. N. Saha startles the reader saying that "in the scale of civilization, India comes as low as China or Abyssinia". Consumption of electrical energy *per capita* is 7 units in India as compared with 1,800 units in advanced Western lands. The reason is not that India has no resources but that its governments have not cared enough to investigate or develop them in the interests of the people. A. N. Tandon discloses the unsatisfactory condition of supply of power in the United Provinces. B. P. Adarkar, agreeing with the other writers, stresses the need for beneficent legislation in India to exploit the power resources for the nation's benefit and not for that of foreign monopolists. Prof. Saha points out that the price of power is artificially maintained in India at four times the price in other countries with consequent retardation of industrial development. N. N. Godbole describes how Japan by organisation increased production eightfold in twenty years and by supplying power very cheeply, at one pie per unit, gives an enormous impetus to her industry and trade. Her electrical industry has gradually come under State control, thus co-ordinating her resources just as the Grid-system existing in England and Russia and advocated in India.

N. G. Chatterji has shown that alcohol from molasses of the sugar industry is a cheap and satisfactory fuel for power supply for agricultural purposes.

The general reader will find Appendix A an easy introduction to the discussions and the several interesting tables and data are valuable to the administrator. At the suggestion of the President, Pandit Jawaharlal Nehru, the Academy has passed resolutions asking the State to undertake a vigorous policy for an accurate survey of our power resources, to provide for the training abroad of a number of Indian engineers who are to develop power in India and to pass necessary legislation.

According to Sir M. Visvesvaraya, hardly the fringe of India's Power has been developed and if the national governments plan a bold outline of a unified attempt after the Russian model, there is no reason to doubt that India will rank, in ten years, with the most advanced countries.

The Academy has to be congratulated on its contribution to the National Planning at such an opportune moment. However, reflecting on man's glorious achievements, would one agree with the statement that "man regarded as an animal producing work is rather a poor specimen" (p. 83).

The booklet is neatly printed except for some typographical and idiomatic errors, *e.g.*, on pp. 57, 69, 84, 87 and 90.

Y. K. RAGHUNATHA RAO.

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(1) **Milk Records of Cattle in Approved Dairy Farms in India.** (Bulletin No. 18), 1938. Pp. 175. Price Rs. 2–12–0 or 4*sh.* 6*d.* (2) **Report on a Village Enquiry Regarding Cattle and the Production and Consumption of Milk in Seven Breeding Tracts of India.** (Bulletin No. 22), 1938. Pp. 127. Price Rs. 3–8–0 or 5*sh.* 6*d.* (3) **The Nutritive Values of Indian Cattle Foods and the Feeding of Animals.** (Bulletin No. 25), 1938. Pp. 39. Price Annas 7 or 8*d.* (Imperial Council of Agricultural Research—Manager of Publications, New Delhi.)

(1) An exceedingly useful publication covering 170 pages, all of which but for the first four pages, is devoted to data running into several tabular forms, has recently been issued. This publication has appeared not a day too soon. Information received from 36 farms is incorporated in these pages.

Short notes on the "conditions of climate, feeding and management" in the various centres mentioned would be a useful addition. To secure uniformity, all dates and years could be according to the British calendar (p. 58, 120). Inclusion of more 'fat tests' by which expression is probably meant fat per cent. would have been welcome.

(2) Another Bulletin (No. 22) also issued by the Imperial Council of Agricultural Research, brings together the most reliable information relating to cattle, and the production and consumption of dairy produce in

the seven breeding tracts of India, comprising 7,600 agricultural holdings. Judging from the quality and the quantity of data presented in this report all of which was collected in a short span of five months, it is an unprecedented success.

Unfortunately it bears the mark of hurried printing. It is surprising that the seven tracts have not been properly indicated in the map and the use of names of provinces in their place in the tables, causes confusion. Such expressions as 'female buffaloes', 'buffalo cows' and 'cow buffaloes' in place of the more usual 'she-buffalo' could have been avoided. The same remark applies to the use of the word 'sweet-meats' to imply 'sweets'. There are a number of other errors which would have been avoided.

(3) Bulletin No. 25 dealing with data relating to results of chemical analysis, digestibility coefficients and the nutritive values of Indian cattle foods with a 14 page introductory note on the scientific principles of feeding of farm animals in general, and of cows in particular is of the nature of a rough and ready guide for the planning of suitable rations for the farm animals. The subject is dealt with in an easily understandable manner and the Bulletin fulfils a real want.

G. N.

Theorie et Technique du Bruit de Fond (Effets Schottky et thermique). By F. Bedeau. (Actualites Scientifiques et Industrielles, No. 574). Hermann et Cie, Paris), 1937. Pp. 95. Price 25 *fr.*

This is a clear exposition of the theoretical and practical aspects of two of the phenomena which give rise to the background noise in a radio receiver. One of these is the fact that the number of electrons emitted from the filament of a valve in short equal intervals of time fluctuates (Schottky effect). The other is the fluctuations in the velocity of the conduction electrons in any resistance due to thermal agitation, giving rise to fluctuating voltages at its ends (thermal effect). These effects play an important part in the performance of a wireless receiver and the book is worth perusing by any one interested in the working of an apparatus which has nowadays become a common article of household furniture.

T. S. S.

Travaux Pratiques de Physique—1. Mesures, Chaleur. Par Maurice Prost. (Actualités Scientifiques et Industrielles, No. 628. Hermann et Cie, Paris), 1938. Pp. 93. Price 25 *fr.*

The volume gives in clear and concise language, the practical methods in a few select elementary problems in metrology and heat. The subjects dealt with are the precision balance, calipers, screw gauge and spherometer, densities of liquids and solids, simple and torsional pendulums, barometry, thermometry and calorimetry, pressure and density of vapours, and cryoscopy, viscometry and capillarity.

C. S. V.

Intermediate Physics, Part I (Mechanics). By Prof. D. S. Jog, M.Sc. (Karnataka Publishing House, Bombay), 1938. Pp. xi + 334.

This book has been written to cover the latest syllabi in Mechanics of the I.Sc. standard. Portions above this standard have been included, these being differentiated from the rest by printing them in small type. The fundamentals of the subject are carefully developed and well expounded.

Although one may deviate from the usual methods of treatment, the reviewer cannot see eye to eye with the author in the intermingling of the two parts Dynamics and Statics, as has been done by him. The experimental aspects of the subjects could have been more profitably enlarged by cutting out short portions not required for the I.Sc. course. Topics like comparison of Masses with the Hick's Ballistic Balance, experiments with the inclined plane and the use of steel yards have not been mentioned at all. On page 39, under measurement of Mass, the reader is referred to Chapter XIV for the theory of the balance. In Chapter XIV, the theory of the balance has been dealt with, while the student is asked to refer to some text-book of Practical Physics for full details for the method of determining the mass of a body by the method of oscillations.

One important and welcome feature of the book is the inclusion of some biographical notes on prominent physicists with their portraits. The book will be of very great use to every serious student and teacher of Physics.

K. Srinivasa Raghavan.

Laboratory Experiments in Elementary Physics. By Newton Henry Black. (Macmillan & Co., New York), 1938. Pp. 263. Price 5/6.

This book is offered as a guide to both student and instructor in the Laboratory work. Sixty-two experiments have been dealt with on various branches of Physics. Descriptions of apparatus to be used have been avoided by introducing photographs of the apparatus themselves. The Introduction, covering about seven pages, contains suggestions to teachers and directions to students, particularly with regard to the latter's record note-books, percentage of error, the care of the apparatus and the like.

One important feature of the book is the fact that a number of questions have been given under each experiment by answering which students could draw conclusions from their own experimental data. The Appendix contains a tabulated statement of a number of physical constants with necessary mathematical formulas and with hints about graphical representation of the results of experiments.

The book can be advantageously recommended as a good guide to accompany Black & Davis' *Elementary Practical Physics*.

K. SRINIVASA RAGHAVAN.

Adhunika Vignanam (Modern Science). By M. Venkata Rao, Vizianagaram. (Sarada & Co., Vizianagaram), 1938, Pp. 50. Price 6 annas.

This is a pamphlet containing a reprint of three popular Science articles in Telugu, first published by the author in some Telugu journals. The first article on 'The Mystery of the Creation' deals with the constitution of the planets and the stars and gives a side-talk on the theory of light, the wireless, radio-activity, television and the airship. The second article is on 'Mantras' in which the author tries to explain their efficacy scientifically in an ingenious manner taking for his help, gravitation, magnetic action, ultra-violet rays and ultra-sonics. The third article is on 'Voyage to the Moon' in which the author describes the phases of the moon, its constitution, the nature of its atmosphere, its gravitational attraction, etc.

The mode of presentation of each of these subjects is very attractive. It is in the form of dialogue between a student of Modern Science, not altogether an unbeliever in the old orthodoxy and an out and out orthodox person who believes that there is nothing new beyond what is contained in the Vedas, the Sastras and the Puranas, and who has little respect for Modern Science.

The language is completely non-technical and colloquial and the style very elegant. Tracts like these dealing with the various scientific subjects ought to be published throughout India in the several languages, in hundreds, solely with a view to create an interest in the people for Modern Science, and as a preliminary to the spread of scientific education.

B. V.

Philosophic Activity in the West.
(1) Actualités Scientifiques et Industrielles, No. 575, 1937. Pp. 21. Price 5 *fr.*;
(2) No. 527, 1937. Pp. 54. Price 12 *fr.*;
(3) No. 572, 1937. Pp. 53. Price 15 *fr.*;
(4) No. 573, 1937. Pp. 62. Price 18 *fr.*;
(5) No. 546, 1937. Pp. 35. Price 10 *fr.*;
(6) No. 592, 1938. Pp. 88. Price 20 *fr.*

The Pamphlets issued under the general series "Actualites Scientifiques et Industrielles" heading bear eloquent testimony to the intensity of the philosophic activity in the West directed to the interpretation of theoretical patterns of thought in relation to practical concerns of life to the extent to which such correlation may at all be possible. The *first* pamphlet deals with the "Actuality of the Platovian Problems", and as some other studies in the series unmistakably indicate, it is obvious that Plato and Aristotle continue to inspire quite a large number of philosophical and critical studies. The *second* has for its subject-matter the "Critique of Measure", and the author discusses the antinomy about Measure. The *third* contains a discussion of the problem of knowledge with reference to Empiricism and Greek Rationalism. The *fourth* is devoted to a study of "Plato and Aristotle". The *fifth* has an "Essay on Two Hypotheses of Parmenides". The *sixth* examines the nature of the "Language of Sciences".

I do not believe it would be possible, within the limits of this notice, to do justice to the contributions made by different authors to specific branches of knowledge, but, some general observations may be quite in order. The pamphlets embody results of investigations pursued from time to time,

and though the results achieved cannot claim permanent and universal validity, they serve to stimulate thought and kindle critical investigation.

Plato and Aristotle still continue to offer the modern world, as it were, many persistent problems of philosophy and it is here just where philosophic speculation or system-building gives rise to more problems than it ever finds itself able to solve, there is the battleground of fight between laboratory science, with its apotheosis of quantitative precision and verification, and metaphysics proper, the concepts of which elude the grasp of laboratory methodology.

The pamphlet on "Parmenides" discusses a highly significant problem of ancient Greek speculation, and though no final solution is ever possible in the nature of the case, the author has focussed attention on the basic concept of the Eleatic system systematized by Parmenides. In Indian Philosophy of course, the problem of the One-and-the-many is as alive and dynamic to-day as it must have been centuries ago when Sri Sankara sternly and courageously championed his monistic interpretation of the Vedanta.

The pamphlet on "The Language of the Sciences" raises important questions concerning the terminology adopted by different sciences, and it must, however, be emphasized that the nature of the reality or subject-matter dealt with largely determines the language used. Certain familiar concepts of religion, philosophy and theology do not lend themselves to be translated into the language of the laboratory sciences.

The pamphlets on Plato and Aristotle and the specific Platovian problem consider what I have described permanent problem of Greek Thought which has moulded and directed European Thought at its best. The comment that European Philosophy largely consists in a periodical (conscious or unconscious) forgetting of the conclusions of Plato and Aristotle and their subsequent discovery or re-discovery, may or may not be quite just, but, it represents pretty fairly a true state of affairs. If we keep aside those systems of philosophy which have agreed readily to embark on a career of self-repudiation or self-stultification in order to come to terms with laboratory sciences, others even to-day are obliged to discuss the problems of Plato and Aristotle. Such a state, however, does not detract from modern philosophic endeavour. It only demonstrates the fact that masterminds like Plato and Aristotle had been blessed with the uncanny gift of a correct perception of the basic problems of philosophy every attempted solution of which only acts as a sharp stimulus to further problems.

The pamphlet on "Theory of Knowledge" in reference to the Empiricism and Rationalism of Greek Thought again in its methodology and attempted solution would remind one only of old wine in new bottles, notwithstanding any Governmental or mental campaign in the direction of fractional or total prohibition. In making this remark, however, I do not mean any disparagement to the excellent effort of the author. The problem of knowledge is also the problem of ignorance. Therein lies the rationale of the fruit of the forbidden tree!

The six pamphlets briefly noticed here, dealing with a variety of subjects indicate how intense and sustained are philosophic activity and metaphysical endeavour in the West. Whether or not one agrees with the conclusions arrived at by different writers, it is impossible to withold tribute and gratitude to them for the systematic manner in which they pursue philosophic quest—a quest which is not in most cases accompanied by quick-returns in the shape of the currency of the land.

R. NAGA RAJA SARMA.

Publications du Laboratoire D'Essais XXIX. Les Cristaux Mixtes et Leur Structure. Par Pieere Dubois. (Actualités Scientifiques et Industrielles, No. 627. Hermann et Cie, Paris), 1938. Pp. 42. Price 12 *fr.*

A brief resumé of the formation of mixed crystals of insertion and of substitution having the same lattice as one of the constituents, as well as those having a lattice different from those of either of the constituents is given. Their significance in relation to the problem of isomorphism is discussed.

C. S. V.

Fishing Methods of the Malabar Coast

MR. JAMES HORNELL, formerly Director of Fisheries, Madras, has recently published the second part of his account of "The Fishing Methods of the Madras Presidency"[1] in which he describes the fishing craft and methods of fishing employed on the Malabar Coast. The first part of this series, it may be recalled, appeared in 1924 and was devoted to the fishing methods of the Coromandel Coast.

The geographical limits of the Malabar Coast are slightly extended to a total distance of more than four hundred miles on ethnological grounds. The area thus defined is divided into three separate sections—a southern, a median and a northern—according to the distinctive types of fishing craft and methods. The southern section is called the Catamaran coast, as the fishermen here use the same type of Catamaran as is used by the fishing communities on the western coast of the Gulf of Manaar; their fishing methods are also closely related, the only difference being the use of a primitive trawl (*Kurukku Made*), which is described in detail, by the former. The median section comprises the coastal region dominated by Malayalees, who use dugout canoes and employ totally different methods of fishing. The northern and last section is coincident with the entire coastline of the South Kanara District. Here the dugout canoes are used for inshore and backwater fishing, and plank-built boats for offshore fishing. The methods used in the last two sections are either similar or differ in minor details, and the author has, therefore, dealt with the fishing methods of both the sections together.

The methods and implements of fishing are different for different types of waters, such as backwaters, estuaries and the sea. The various methods and implements used in these waters are described in detail, and illustrations and vernacular names are given so far as possible.

The paper is of additional importance on account of the ethnological information embodied in it. According to the author some of the implements are not indigenous, but had been introduced during the time of early influence of the Europeans on the Malabar Coast. For instance, the South Indian Cross Bow, in common with that of West Africa, is undoubtedly of European origin. The author supports this hypothesis on two considerations, namely, its vernacular name and the character of its release. The Malayalam name of the Cross Bow is 'Parangi pathi'. 'Parangi' is the Dravidian corruption of 'ferringhi' or Frank; this term in later times has come to be accepted as the virtual equivalent of Portuguese and hence the association of this weapon with the Portuguese. The details of the release are identical with those of the typical mediæval Cross Bow used in Europe in the sixteenth century. Similarly, from the vernacular name of the Chinese Balanced Dip-net used exclusively near Cochin, it is generally assumed to be an introduction from China, as are several other items in the material culture of Malabar. The author is however, against the theory of its direct introduction by the Chinese, who were undoubtedly trading with India prior to the arrival of the Portuguese, for, the technical terms in use in Cochin for the principal parts of this complicated implement are of Portuguese derivation. Cochin being their chief settlement on the Malabar Coast, the Portuguese might have introduced this effective dip-net after noting how the Chinese use it with great advantage and skill. Another rather unusual fishing method is the one in which a sickle is used; according to Hornell, the use of this agricultural implement in fishing outside India is only known from the Channel Islands and the northern coast of France.

Another very useful feature of the paper is the large number of beautiful photographs illustrating the life and methods of fishing of the people of the Malabar Coast.

K. K. NAIR.

[1] *Madras Fisheries Bulletin*, 1938, No. 27, pp. 1–69; 21 text-figures, 11 plates.

INDUSTRIAL SECTION

Stainless Steels*

IN the courtyard of a mosque near Delhi, there stands an iron pillar nearly 24 feet high, 15¼ in. in diameter and weighing about six tons, which was erected about A.D. 300. It is very interesting to know that the Indian craftsmen of that day were able to fashion so large a piece of iron at a time when all other peoples then, and for centuries later, could only forge iron in the form of small pieces for use as weapons, tools and household appliances. *Still more remarkable is the fact that that pillar has withstood the ravages of time and atmospheric corrosion up to the present day.*

Since the days when that pillar was set up, the metallurgy of iron has made enormous strides. The invention of blast furnaces and the art of steel making, the development of rolling mills, steam hammers and hydraulic forging presses, aided by scientific investigation of the physical and chemical properties of iron and steel have, so to speak, changed the face of the earth. But for all that the problem of protecting iron and its alloys from the weather, and from attack by chemical agents was not solved until about thirty years ago, at a time when the iron and steel industry had already attained a remarkably high state of efficiency.

In the year 1909, the metallurgical engineers of the Krupp Works were conducting experiments in search of a heat-resisting steel suitable for Pyrometer sheaths. The experimental melts made by them contained chromium in varying amounts. These alloy steels proved satisfactory in respect to scale resistance at elevated temperatures, but at the same time it was perceived that some of the alloys tested remained perfectly bright for months in the highly corrosive atmosphere of the laboratory. That was indeed a turning point! There in the metallurgists' hands was the very first iron alloy capable of resisting intense chemical attack!!

Systematic scientific investigation of these alloys was forthwith organised, one of the main objects being to develop methods of heat-treatment that would render these then extremely hard metals amenable to shaping and machining processes.

When these problems were successfully solved, the Company's Metallurgists devoted themselves to the task of improving the methods of fabricating these valuable metals so as to enlarge their sphere of usefulness. The technique of welding, in particular, was brought to a high state of perfection, so that to-day rustless steel plant up to the largest sizes can be built up by welding at site.

The great variety of working conditions which rustless steel is required to meet, led to the evolution of a number of different types of this metal, and in addition to two corrosion-resisting alloys, the most important of these being the VA and VM groups. The various groups differ from each other in chemical composition and physical properties. Their chief characteristics are:—

The 'VA' Group

Composition: (*a*) About 18 per cent. chromium and 8 per cent nickel, with a low carbon content. (*b*) Other ratios of chromium to nickel, to which are sometimes added other alloying elements.

They possess an austenitic structure and are non-magnetic. They are not hardenable by quenching, and are available with tensile strengths varying from 35 to 48 tons per square inch.

For this group, generally speaking, the differences in tensile strength existing between the various types is of less importance than other considerations such as corrosion resistance and easy workability. These steels are the most important as far as the chemical industry is concerned. In addition to possessing the highest corrosion and acid-resisting properties of all steels, they are comparatively easily workable, as they possess good deep drawing qualities and are easily welded. Up to a comparatively short time ago, it was necessary to heat-treat all

* From a paper read by Mr. K. N. Prahlada Rao, B.Sc. (Met.), of Messrs. Krupp Indian Trading Co., Ballard Estate, Bombay, at a Symposium on "Materials of Construction in the Chemical Industry" held at Bhadravati, under the joint auspices of the Association of Technologists, Mysore, and Technological Association, Bahdravati, on April 7, 1939.

stainless steels after welding in order to restore their corrosion-resisting properties, which were affected by the welding process. In the case of larger parts, which could not be easily treated, this was a serious disadvantage. Now this disadvantage has been overcome and types are available that do not require any heat-treatment after welding.

Of all corrosion-resisting steels and alloys, the "VA" Group offers the widest field of application. Even at higher temperatures they are absolutely resistant to corrosion by numerous organic and inorganic acids, bases and salts. They are indispensable in up-to-date plants for the production of nitric acid, artificial fertilisers, explosives, artificial silk, photographic films, dyestuffs, oils, soap, paper and textile goods. They are widely used in breweries and distilleries, and in the dairy and foodstuffs industries.

The 'VM' Group

The next group to be considered is known by the designation "VM". The steels in this group have a composition of from 12 to about 18 per cent. chromium, with varying carbon contents. They possess a Troostito-martensitic structure, and are magnetic. That they are hardenable by heat-treatment gives them a special value for certain applications, where this property is essential. The tensile properties can be varied by heat-treatment to meet specific requirements. In the heat-treated state, owing chiefly to a difference in carbon content, their tensile strengths range from 41 up to 102 tons per square inch.

The development of the "VM" steels is a triumph of the Metallurgists' endeavours to make stainless steels with greatly varying tensile strengths to meet the needs of an immense number of different types of industrial plant. They are primarily intended for use as constructional steels for general engineering purposes and similar applications, but not for welded work. There are special types suitable for parts subject to heavy mechanical stresses, as, for instance, shafts, piston rods, valve stems and seats, turbine blading, ships' propellers, etc.

Another type has been developed to meet those cases where a high degree of hardness up to 530 Brinell is essential, *e.g.*, machine knives, plungers, measuring instruments, ball and rollers for bearings, etc.

The "VM" Group of steels depends to a considerable extent on heat-treatment and surface finish for its corrosion-resisting properties. Provided these are given the necessary attention, excellent results are obtained.

The 'VF' Group

The next type of steels to be considered lie within what is known as the "VF" Group. These contain over 12 per cent. chromium with a very low carbon content. They have a ferritic structure and are magnetic. They are not hardenable by heat-treatment. As they have a ferritic structure, heat-treatment produces no change in the structure of the steels, or at the best a partial change only. It follows, therefore, that heat-treatment cannot modify the mechanical properties of these steels to any appreciable degree. The most widely used types have a tensile strength of from 35 to 41 tons per square inch. They are used for constructional purposes in cases where the parts are not subject to severe mechanical stresses. Corrosion resistance is about equal to that of the steels in the "VM" Group. As they are somewhat cheaper than the steels of the latter group, they are used instead of that material wherever possible. They have not found extensive employment in the fabrication of chemical plant because the weldability is rather limited. Nevertheless, when selected for suitable purposes, they give excellent results and immunity from corrosion.

Nirostaguss Alloy

Under Group IV, is included the "Nirostaguss" alloy. This contains over 24 per cent. chromium, from 1 to 2 per cent. carbon and dependent on the use to which it is to be put, with or without an addition of nickel and/or molybdenum. The alloy is a ferrito-ledeburitic or austenitic structure according to the nickel content. The magnetic properties are also dependent on the composition as stated before.

"Nirostaguss" resembles cast iron inasmuch as it shows no elongation to speak of, and is also rather sensitive to shock. The tensile strength of "Nirostaguss" is about twice that of ordinary gray iron. The alloys are immune from attack by numerous chemicals. They are useful substitutes for casting purposes in such cases where steels of the "VA" Group are not absolutely indispensable, or where such steels cannot be

employed on the grounds of founding technique. They are used especially in the nitric acid industry and pulp industry; furthermore, for drying cylinders for the paper industry, etc.

Thermisilid Group

The last group of stainless alloys to be dealt with is known as "Thermisilid". This is actually a high silicon cast iron, which is remarkable for its excellent resistance to many kinds of corrosive attack. The material is produced by a special founding process. These alloys resist attack by a number of corrosive agents against which alloy steels proper are not proof. Unfortunately, their sphere of usefulness is limited by a certain lack of ductility, owing to which their employment is restricted to such parts of chemical plant as are not subject to severe mechanical stresses. For all that, and particularly if suitable protection against shock is provided, the "Thermisilid" alloys may be employed to great advantage in the form of apparatus, piping and fittings in acid manufacturing plants, explosive factories, dye works, pickling plants and many other kinds of chemical works.

Heat-resisting Alloys

Heat-resisting alloys which are in many ways related to the stainless alloys and which also serve many useful purposes in the chemical and allied industries have been developed to meet a number of requirements. The most essential of these being:—

(1) Corrosion resistance particularly at elevated temperatures. Under this head comes scale-resistance, by which term is understood immunity to oxidation at high temperatures, and also resistance to attack by sulphurous gases and similar corrosive media. (2) Retention of mechanical strength and shape at elevated temperatures. (3) Retention of mechanical properties in repeated heating and cooling operations. (4) Special physical properties. A further important requirement is good ductility.

As regards the economic aspect of the use of heat-resisting alloys, it can be stated as a general rule that a saving in production cost is effected not only through increased length of service of plant, but also owing to certain incidental factors such as reduction in weight and resultant fuel economy, less idle time of plant due to repairs, replacements, etc.

In comparison with ceramic refractory materials, the better thermal conductivity of the heat-resisting alloys, their greater toughness and resistance to blows and shocks, as well as the possibility they offer of repairing fractured parts, are distinct advantages.

The advent of heat-resisting alloys has solved many baffling problems of metallurgical and chemical equipment design.

Two essentially different types are produced. The first of these have an austenitic structure and the second have a semi-ferritic or entirely ferritic structure. The service temperatures at which they can be safely employed vary from 800° C. up to 1300° C. Generally speaking, their most important features are the corrosion resistance at elevated temperatures and tensile properties and retention of strength at elevated temperatures.

For many years, the heat-resisting steels have been put to numberless uses in the chemical industry, for example for annealing tubes and muffles, protective sheaths, crucibles, retorts, rabbles for roasting furnaces in various industries, *e.g.*, sulphuric acid manufacture, apparatus and conduits for hydrogenation processes, etc. They have also been extensively used in the enamelling trade, engine construction, furnace construction, porcelain and ceramic industries, and so on.

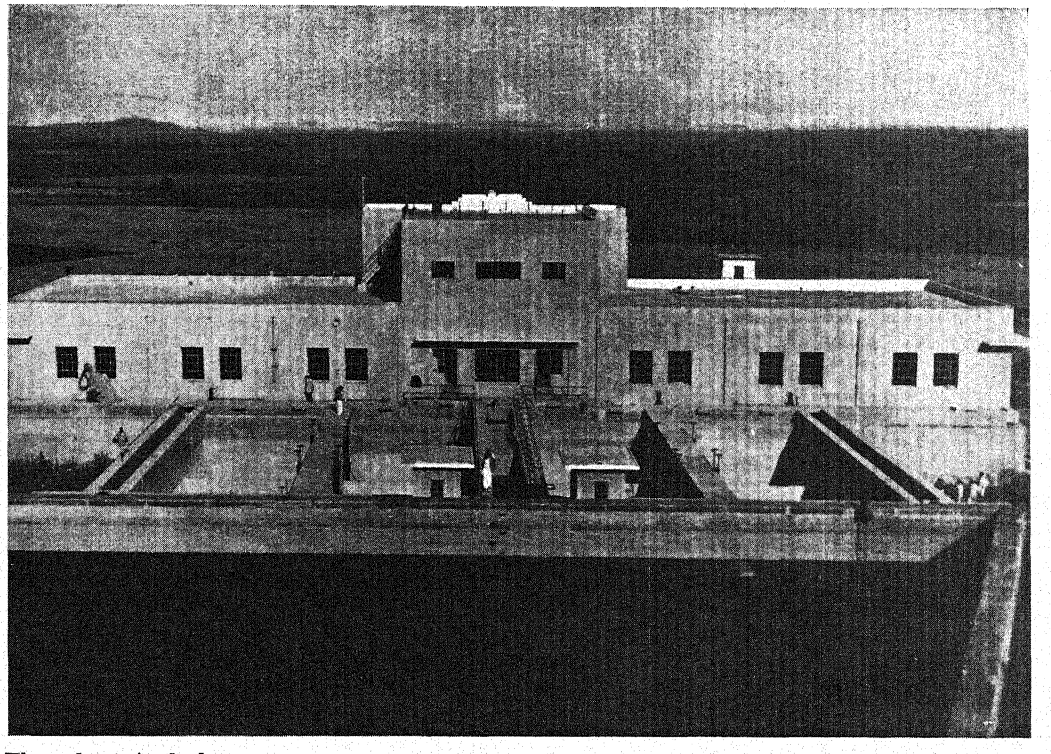
The discovery of rustless steels and alloys, and heat-resisting alloys, is one of the outstanding achievements of the human mind. Numerous chemical processes are indebted to these materials for their practical application on a manufacturing scale, while a still greater number of others have been placed on a far sounder economic basis than formerly by the use of a plant made of them. For a great variety of other purposes, the application of stainless steels ensures spotless cleanliness and the acme of sanitary perfection. It will certainly not be long before this excellent metal is used to the exclusion of all others for hospital, hotel, restaurant, and even private household utensils, fittings and appliances, with the result that this really epoch-making invention, which has already had such a far-reaching influence on industry, will eventually confer its benefits upon human society at large.

Indore City Filtration Plant

By Rao Bahadur B. L. Modak, M.C.E.
(Executive Engineer in charge of Indore City Water Supply)

THE purification plant is a modern Rapid Gravity Filter Plant.

The capacity as constructed is six million gallons per day, but equipment has been provided at present for only four million gallons per day. The ultimate capacity of the plant will be eight million gallons per day.



The plant includes:—

(*a*) Dosage of Coagulants.
(*b*) Mechanical mixing of Coagulants.
(*c*) Odour Control.
(*d*) Aeration.
(*e*) Aggregating Tanks.
(*f*) Settling Tanks.
(*g*) Sludge Removing Equipment.
(*h*) Filters.
(*i*) Sterilizing Plant—Chloramine Process.
(*j*) Corrosion Control.

Coagulants

Provision has been made for the addition of any or all of the following chemicals:—alumina, sodium aluminate, soda ash and lime. This flexibility will enable any condition of the raw water to be treated efficiently and economically.

Alumina, sodium aluminate and soda ash would be proportioned and added in solution form, while lime would be controlled by a Dry Chemical Feeder.

Mechanical Mixing of Coagulants

The most efficient use is made of the coagulants by proper mixing after addition to the water. This is done by means of two Flash Mixers arranged on the inlet to the Aggregating Tanks.

Odour Control

The removal of unpleasant odours from the water when they occur, will be carried out by the addition of powdered activated carbon which absorbs the odour-producing substances, usually oils from decaying animals and vegetable organisms. The powder

is added before the filters and is removed with the adsorbed oils in the filters.

The action of the carbon is assisted by aeration of the water prior to settlement.

Aeration

At certain seasons the water is known to contain iron, and aeration is provided to deal with this impurity. Besides oxidation of the iron, aeration materially assists in coagulation and odour removal. The aeration is provided in two chambers into which compressed air is blown.

Aggregating Tanks

After the addition of the coagulants and adequate mixing, the water is brought to the aggregating tanks, or primary settling tanks, in which the flocculent particles are conditioned to increase their size and density, making them fall more quickly in the Settling Tanks. This is effected by contact between the sludge already formed in the bottom of the tanks and the incoming water. This contact enables the necessary chemical reactions to go rapidly to completion and the controlled agitation provided by a 'snow balling' action, increases the density and size of the particles.

Settling Tanks

The settling tanks are of the horizontal flow type which are found very efficient in dealing with an adequately 'conditioned' water. They are designed to give a steady and even flow with the minimum of eddying to water passing through them. To this end no baffles are provided but the design of outlet and inlet are such that full use is made of the tanks.

Sludge Removal

Sludge can be removed from both the primary and secondary tanks without interrupting the section of the plant. Both sets of tanks are provided with hopper bottoms which collect the sludge falling from the water in its passage through. These hoppers are designed so that all sludge falls to the bottom of the hopper and is withdrawn by a sludge outlet provided at this point.

This special design eliminates the necessity for putting the tank out of operation for draining down and removal of the sludge by hand.

Filters

The filters are the heart of the plant. All that goes before is conditioning to make the water suitable for filtration.

Each unit is capable of dealing with one million gallons per day. The area of the filter bed is 600 square feet so that the rate of filtration is 1,666 gallons per square foot per day, or 69·4 gallons per square foot per hour. Four units are fully equipped and the masonry work for six has been completed.

All filter controls have been centralized so that the whole operation is carried out from the control platform in front of the filter. These controls are mounted on a table and the opening and closing of the valves, starting and stopping of motors are carried out merely by turning levers or pushing buttons. Also on this table are indicators consisting of dials and signal lights which tell the operator exactly what is happening and record on a chart the rate of flow and the loss of head through the filter.

Power for the operation of the valves is provided from a central hydraulic accumulator with automatic pressure control to the high pressure booster pumps. The valve position indicators are operated by "Teleflex" cables. The signal lights are electrically operated from each control table and there is a master panel in the main office giving a complete indication of the working of the plant to the Supervisor. The starting and stopping of the motors is arranged for push button control from the control table with automatic starters by the motors.

The cleaning of the filter beds is carried out by a new and highly efficient method. Compressed air and water are used, as is usual with other systems but these are arranged for simultaneous application. In addition the patent 'Surface Flush' of the bed after cleaning is incorporated and this enables all dirty water on the bed to be removed from the top of the filter before it is again put into service.

The result of this modern system of filter cleaning is that the filters are kept in an exceptionally clean condition, consistent with efficient filtration, and the consumption of power and wash water is reduced to a minimum.

The flow of water through each unit is controlled by a 'Modern' and a 'Slow Start'. The former controls the rate of flow during normal working while the latter automatically shuts and opens the module before and after cleaning. The opening of the filter after washing has to be done slowly and gradually to ensure that the effluent is

always up to standard. This is not the case if the unit is put into operation immediately after washing at the full rate.

The provision of these modern and automatic units makes for greater efficiency and lower running costs. The case of carrying out the washing operations means that the units are out to operation for a much shorter time and therefore the nett filtering capacity is increased.

The recording instruments provided enable an infallible check to be kept on the performance of the plant by the responsible officer.

Sterilization

After the filtration the water will be clean and bright and free from all suspended matter. Approximately 95% of all bacteria will have been removed but to ensure that there is no possibility of any harmful bacteria passing into the distribution system, a minute dose of chlorine and ammonia is added to the water.

These chemicals will sterilize the water and will also provide the water with a resistance to after-infection so that any pollution finding its way into the distribution system is counteracted.

Corrosion Control

The action of water on steel and cast iron is often the cause of rapid and costly deterioration of the distribution system. Corrosion is controlled by adjustment of the pH of the water and this will be raised when required by the addition of lime after filtration.

Laboratory

A chemical and bacteriological laboratory is provided and tests are carried out as a matter of routine to ensure that proper purification is taking place.

Softening

A feature of the plant is that provision has been made in the design so that when the ultimate capacity of eight million gallons per day is installed, two million gallons of this can be softened by the Lime Soda Ash process. This was done as it was felt that a softened supply would be appreciated by the mills and other industrial concerns in Indore.

General

The plant was designed by the author with the assistance of Candy Filters (India) Ltd., water purification specialists. All equipment was provided by this firm.

India's Forest Pests

THE biological data collected at the Forest Research Institute, Dehra Dun, after years of research and now made available to the public in a recent publication in the *Indian Forest Records* (new series) Entomology, have been found to be of great assistance in organising a fight against the numberless pests which cause enormous losses to India's forest wealth.

The average annual loss due to the sal borer, for instance, in Government forests alone is not less than Rs. 2,50,000, while in epidemics the loss may rise to enormous proportions.

In a small epidemic affecting eight square miles of forest in the United Provinces, 45,000 trees with timber content of nearly a million cubic feet, were killed with a loss of Rs. 2,70,000.

The most serious epidemic on record was one which affected five forest divisions of the Central Provinces, an Indian State and extensive private land. When remedial measures were taken, it was found that, on 150,000 acres of sal forest in two divisions, timber, valued at about Rs. 7,50,000 had been destroyed. In the following year the attack extended to 5,500,000 trees in this area, with a loss of forest capital of nearly Rs. 1,37,50,000. Before the epidemic was checked, the total number of trees attacked over the whole infested area rose to 7,000,000. Four years of control operations and an expenditure of Rs. 1,25,800 were necessary, before the epidemic was definitely overcome.

Particularly injurious to avenue and shade trees planted in towns and along roads, especially willows and poplars, is a pest called *Æolesthes sarta*. It also works damage in fruit orchards. The avenue and garden trees of Quetta were severely attacked by this borer in 1904–06, necessitating the felling of some 5,000 trees. Over 20,000 beetles were collected and destroyed in 1905 and 3,000 in 1906.

Another beetle (*Chlorophorus strobilicola*) which attacks the cones of pines from altitudes of 2,000 feet to 6,500 feet, is the commonest in open sunny stands of chir pine. The damage done is almost negligible in a good seed year, but when cones are few the proportion infested may rise to even as high as 40 per cent.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(University Librarian, Madras)

Saunderson, Nicholas (1682–1739)

NICHOLAS SAUNDERSON, a blind British mathematician, was born at Thurston in Yorkshire, January 1682. He became blind from smallpox at the age of twelve months. In spite of it he attended the free school at Penniston and learnt the rudiments of Greek and Latin. His father, who was an excise man, soon observed the predilection of his son for mathematics and taught him the elements of arithmetic. Two friends perceived the remarkable talent of this blind youth and taught him algebra and geometry. By the help of a retentive memory and the power of his genius, Saunderson discovered methods of investigating problems of considerable intricacy.

As Professor

He went to Cambridge in 1707 and began to teach mathematics at Christ's College. Newton's *Principia* was one of the books he taught and he had many students. The peculiar circumstance of his career brought him into friendship with Sir Isac Newton and other prominent mathematicians. When the Lucasian professorship of mathematics fell vacant in 1711, Queen Anne conferred on him the degree of M.A. on the recommendation of Newton and this qualified him to be appointed to that chair. He used to lecture seven or eight hours a day. When George II visited the University in 1728, Saunderson was, by royal authority, made Doctor of Laws.

His Publications

The lectures which he composed for class use were published posthumously. One was the *Elements of algebra.* It came out in two volumes in 1740. Another on fluxions including a commentary on Newton's *Principia* came out in 1756. The first book contains a description of a mechanical device invented by Saunderson to facilitate computation by the blind.

A Psychological Curio

Lord Chesterfield who had attended his lectures described him as a professor who had not the use of his own eyes, but taught others to use theirs. His sense of touch was so keen that he could distinguish "in a set of roman medals the genuine from the false, though they had .... deceived a connoisseur who had judged by the eye". His ideas of the forms which plane or solid figures would assume in different perspectives were said to be remarkably correct. The remarkable achievement of this blind man stimulated a good deal of speculation along psychological lines. Dr. Reid devoted a portion of his *Inquiry into the human mind* to a discussion of Saunderson's powers. Burke also devoted about a page to him in discussing "words which do not raise images" in his *On the sublime and the beautiful.*

Saunderson died April 19, 1739.

Wood, James (1760–1839)

JAMES WOOD, a British mathematician, was born at Turton in Lancashire December 14, 1760. His father, who was a weaver, himself taught arithmetic and algebra to his son. In 1778 he joined St. John's, Cambridge, as sizar. He steadily worked his way until he became a senior wrangler. He became master of his college in 1815 and Vice-Chancellor in 1816. He resided in the college for about sixty years and when he died he had bequeathed his library and about £50,000 to his college. A statue was erected in the anti-chapel.

His Publications

Wood's works were for many years standard treatises. His *Elements of algebra* which came out in 1795, went through several editions and held the field for nearly a century. As late as 1892 an Indian edition of the same was published by P. Ghosh "Remodelled simplified .... with numerous exercises, examples, and Calcutta, Bombay and Madras University examination papers". The *Principles of mechanics* (1796) was a popular text-book till late in the nineteenth century. So also was the case with his *Elements of optics* (1798). Wood was a fellow of the Royal Society and wrote a paper on the *Roots of equations* (1798) to its *Philosophical transactions.*

Wood died in college April 23, 1839.

Burrill, Thomas Jonathan (1839–1916)

THOMAS JONATHAN BURRILL, an American botanist and microscopist, was born on a farm near Pittsfield, Mass., April 25, 1839. While still a child he was sent to work in a cotton mill. Later in 1862, he was sent to the Illinois State Normal School, where the museum of the State Natural Historical Society attracted his attention. The entomologist and the botanist of the museum took interest in him and guided him in his studies. He graduated in 1865 and three years later entered the staff of the University of Illinois.

Publications

He soon conducted a natural history survey of the State and in 1869 he began a series of contributions to the learned organs of his State which he continued with vigour and precision right upto 1915, the articles numbering as many as eighty-two. He was for nearly half-a-century the moving spirit in all the natural history activities of Illinois.

Microscopy and Bacteriology

Burrill was among the pioneers of microscopy in America. In 1877 he announced his suspicion that the terrible epidemic of "fire-blight" of pears was caused by bacteria, which had previously been supposed to cause disease only

in animals. His views were received with scorn in Europe but by 1880 his intensive microscopical investigations and his inducement of the disease in healthy pears by inoculation confirmed his announcement as beyond all scorn and doubt. His prediction that many mysterious diseases such as mosaic blight would prove to be bacterial had been later confirmed. His pathological investigations included such important crop diseases as ear rot of corn, potato scab, blackberry rust, peach yellows and bitter of apples. His last work was an attempt to cultivate the beneficial bacteria of the soil.

Burrill died April 14, 1916.

ASTRONOMICAL NOTES

A Lunar Eclipse.—On May 3, will occur a total eclipse of the moon, visible in India. The circumstances of the eclipse are as follows:

Moon enters umbra	6^h	58^m	p.m.
Beginning of total eclipse	8	10	,,
Middle of eclipse	8	41	,,
End of total eclipse	9	13	,,
Moon leaves umbra	10	25	,,

The times are given in Indian Standard Time. The magnitude of the eclipse is 1·182, taking the moon's diameter as unit.

Planets during May 1939.—Both Mercury and Venus will continue to be visible as morning stars; the former reaches greatest western elongation (26° 55′) on May 1. Venus is slowly getting closer to the sun and becoming fainter. On May 17, the planet will be in conjunction with Saturn. Mars which will be on the meridian about an hour and a half before sunrise, is favourably situated for observation during the late hours of the night. It is getting brighter, the stellar magnitude increasing from −0·2 to −1·1 in the course of the month.

The major planets Jupiter and Saturn will also be visible as morning stars. The ring eclipse of Saturn is gradually widening the angular dimensions of the major and minor axes being 36″·7 and 9″·0 respectively. Uranus will be in conjunction with the Sun on May 9.

Comets.—Information has been received (U.A.I. Circular 752) of the discovery of a periodic comet by Vaisala on March 14, in the constellation Leo. The object was diffuse without central condensation or nucleus, and very faint, of magnitude 15. The period is stated to be approximately ten years.

It is announced that Jeffers at the Lick Observatory, has re-discovered comet Pons-Winnecke on March 17, very near the computed position. At the time, it was a faint object, moving in a north-easterly direction in the constellation Bootes. The ephemeris indicates that the comet will increase considerably in brightness in April and May. At the last apparition it was bright enough to be visible with the naked eye for a number of days.

Comet Kozik-Peltier (1939 a) has been well observed. It has now moved far south and become very faint.

T. P. B.

SCIENCE NOTES AND NEWS

Prof. Max Born, Professor of Natural Philosophy, University of Edinburgh, has been elected this year a Fellow of the Royal Society.

Prof. Born is distinguished for his researches in many branches of Mathematical Physics and his recent researches on the New Field Theory have attracted considerable attention. He was associated with the Indian Institute of Science, Bangalore, during the period September 1935–March 1936 as Visiting Professor and during this period he helped to establish a flourishing school of Mathematical Physics at Bangalore.

* * *

Archaeological Finds of considerable importance have been unearthed at the ancient mound of Surkhanvali Ahli near Devanpura in Punjab, as a result of excavations carried out under the leadership of Dr. C. L. Fabri, Field-Director of the Punjab Exploration Fund. Earlier excavations had revealed the remains of an old city belonging to the times of the Moghul Emperors. Further digging resulted in unearthing the remains of a second stratum, some 100–200 years older than the upper level and herein were discovered the remains of a second city, belonging in all probability to the period of Shah Jehan and his predecessors. A large number of antiquities, including household pottery, glass bangles, iron tools, coins, pieces of leather and cloth, etc., have been collected for study.

Further excavations have shown a third stratum, about 9 feet below the second, and here too were found the remains of walls, fireplaces and numerous objects of interest belonging to the earliest period of Muslim rule in the Punjab.

In a letter dated March 30th, received here, Field-Director C. L. Fabri announces that a lower and earlier strata has since been reached. "Yesterday's finds include a potsherd inscribed in early script, certainly much before the arrival of Islamic peoples and it came from the neighbourhood where a terra-cotta head, probably of Buddha, had been found a few days earlier. The site thus fulfils my hopes in being a magnificent collection of successive habitations, such as was badly needed for a proper establishment of **Indian Archaeological Chronology**".

* * *

Mayan Culture.—The unearthing of a colossal sculptured head of stone and several inscribed monuments, some of the Mayan culture, in a region of Mexico more than a hundred miles outside the previously known "Mayan area" has been announced from the Washington, D.C., headquarters of the National

Geographic Society. The discoveries were made near the village of Tres Zapotes in the State of Vera Cruz by an expedition conducted jointly by the Society and the Smithsonian Institution.

"Significance of the discovery to archæologists", says the announcement, "lies in the fact that science has never before had conclusive evidence that the Mayan civilization extended farther west than a north-south line crossing the western portion of the State of Tabasco at the southern end of the Gulf of Mexico. East and south of this line, in the States of Tabasco, Chiapas, Campeche and Yucatán, Mexico, and in parts of Guatemala, Honduras and British Honduras, are scores of ruined cities and thousands of elaborately carved monuments left by the Maya. These people who have been called 'The Greeks of America,' developed the highest civilization reached in the New World before the arrival of Europeans.

"The only previous indication that Mayan civilization reached farther westward along the Gulf coast was the finding in 1902 of the Tuxtla Statuette, near the city of San Andres Tuxtla, Vera Cruz. This small carved object, now in the National Museum in Washington, bears date in Mayan numerals that has been interpreted as corresponding to 98 B.C. It is thus the oldest dated Mayan object known to exist; but because it is light enough to be easily transported, some archæologists have not been willing to accept the implication that Mayan culture once flourished near San Andres Tuxtla.

"The monuments now being uncovered by the Geographic-Smithsonian Expedition are near and even slightly farther west than San Andres Tuxtla. They are massive and are obviously in the situations in which they were erected. Their discovery not only extends to a considerable distance the known western limits of Mayan cultural influence, but also confirms the significance of the Tuxtla Statuette.

"One of the newly discovered monuments at Tres Zapotes bears a date in the same system of Mayan numerals as those appearing on the Tuxtla Statuette. Although the complete correlation of this date with the corresponding year of the Christian calendar has not been worked out, sufficient progress has been made to determine that the monument was erected during early rather than late Mayan times. So important is the interpretation of this date considered that a number of American and Mexican archæologists have been invited to Tres Zapotes to confer with Matthew W. Stirling of the archæological staff of the Smithsonian Institution, who is in charge of the field work.

"Thirty Mexican labourers are at work daily excavating the plaza, surrounded by mounds, where the colossal head was discovered. Several carved monuments, or stelæ, have been found protruding from the mounds. During the excavations the workmen have uncovered hundreds of pottery figurines of men and animals, and many pieces of broken pottery.

"The colossal head, which was the first object to be unearthed, was found to be nearly six feet high from the base of the neck to the top of the head-dress, and nearly 18 feet in circumference. The largest of the monuments so far discovered is more than 17 feet long and nearly a foot and a half wide. Approximately 30 mounds scattered over a distance of about two miles, have so far been mapped in the Tres Zapotes group."

* * *

The Warkalai Formation in Cochin.—In the course of a communication addressed to us, Mr. T. Sudhakara Menon, Maharaja's College, Ernakulam, reports the occurrence of certain beds in Cochin which bear a close lithological resemblance to the well-known Warkalai formation of Travancore. The laterites with white clay deposits below them similar to those found at Warkalai and Kundara in Travancore, are also seen in Mulanthuruthi, Pulloot, Krishnankotta, Chendamangalam, Karupadanna and other places in Cochin State. Further, several small and isolated lignite beds have also been observed in the "Kole" paddy fields near Kunnamkulam, Enamakkal, Irinjalakuda and other places. These facts show that the Warkalai formation extends into Cochin State also.

This observation is important in view of the fact that Mr. K. K. Sen Gupta in his report on the geology of Cochin definitely asserted that the Warkalai formation does not occur in Cochin State.

* * *

A New Technique for the Measurement of Adsorption of Gases and Vapours on Solids.—Chambers and King (*J. Chem. Soc.*, 1939, p. 139) have described a new technique capable of detecting very small changes of adsorption by a direct reading, floating balance method. The measuring apparatus consists essentially of a Nicholson hydrometer floating in mercury and carrying the adsorbent in the pan. The hydrometer sinks or rises during adsorption or desorption and the level of a reference mark is read with a cathetometer. The great advantage of this apparatus lies in the fact that it combines high sensitiveness and high capacity, so that it is capable of detecting a change of weight of about 1 part in 100,000. The technique seems to be of particular value in the verification of the discontinuities in adsorption isotherm such as have been reported by Allmand and coworkers.

K. S. G. D.

* * *

Fishes of the Genus *Andamia*.—A very valuable contribution to the biology of *Andamia* has been made by H. S. Rao and S. L. Hora in a recent paper by them (*Rec. Ind. Mus.*, 1938, 40, Pt. IV, p. 377). Dr. Hora discusses the systematics of the two species of this genus, *Andamia heteroptera* and *A. raoi*, of which the latter is new. Dr. Rao has studied the ecology and bionomics of the two species. *Andamia* is a little Blennid fish occurring along the Andaman coast and the two species differ in the character of the dorsal spines and anal fins. Each of these further exhibits sexual dimorphism. The fishes occur in their natural habitat clinging to the coastal rocks and move very much like the mud skippers crawling on rock surfaces exposed to wave action. Provided with wide pectoral fins and ventral sucker they are able to maintain their hold on the slippery surfaces. They feed on algæ scraping them off

by their fine teeth. They appear to be capable of a certain amount of aerial respiration.

* * *

Prostomial Glands of the Indian Leech.—The function of the prostomial glands of Gnathobdellid leeches was for a long time obscure and M. L. Bhatia (*Journ. Morph.*, 1939, 64, 37) has conclusively demonstrated that they serve a very important function in the Indian leech, *Hirudinaria granulosa*. The prostomial glands of this leech are unicellular, deeply lying glands. During development, they are seen to arise from the ectoderm though they sink into the deeper layers, later. They are quite distinct from either the salivary or the clitellar glands. The cocoon of this leech is formed by the clitellar glands and is provided with two solid plugs at the two ends. It is the view of the author that the plugs of the cocoon are the products of formation of the prostomial glands. He cites a number of experiments he has conducted by which he has arrived at this conclusion. Leeches from which the prostomium has been severed secrete cocoons which have no plugs and leeches which are disturbed during the act of cocoon formation often withdraw themselves from the cocoon, without forming plugs.

* * *

Microscopic Examination of Cement Clinkers.—The identification of free MgO in cement clinkers is of importance in view of the fact that evidence is accumulating to show that excessive expansion in concrete has been caused by the hydration of crystalline MgO present in it. A satisfactory method for the identification of MgO based on the microscopic examination of polished specimens by reflected light, has just been described (*Instrument Bulletin*, Bausch & Lomb, March 1, 1939). Free MgO observed by this method is found to occur in small angular grains with a reflectivity greater than that of other constituents except C_4AF. Failure, heretofore, to identify free MgO in polished sections was found to be caused by difficulty in proper polishing. Unless polished with extreme care, the edges of the MgO grains are fragmented and secondary scratches beginning from these fragmented areas cover the surface of the specimens. The method for preparing the sections for examination is described in full detail in the Bulletin. MgO can be determined quantitatively in the polished specimens by the use of the integrating stage. Those who are interested in a complete discussion of the microscopical examination of cement are referred to the following publications available from the Superintendent of Documents, Washington, D.C. (U.S.A.):—H. Insley, *J. Res., National Bureau of Standards*, 1936, pp. 917; Insley & McMurdie, Research Paper, 1938, RP 1074.

* * *

Indian Central Cotton Committee.—The problems connected with the present position of cotton and the measures for dealing with them formed the principal subjects of discussion at the meeting of the Indian Central Cotton Committee held on the 31st March 1939, under the Chairmanship of Sir Bryce Burt, Vice-Chairman of the Imperial Council of Agricultural Research and President of the Indian Central Cotton Committee. The Special Sub-Committee which was appointed to examine the matter from all aspects met on March 27th and 28th under the Chairmanship of Sir Chunilal Mehta, Vice-President of the Committee, and its report and recommendations served as the basis of discussion at the main Committee.

In connection with the need for securing better balanced production of different cottons, it was suggested that efforts should be made to obtain fresh breeding material showing variability and combining resistance to drought and disease with good ginning percentage, lint length, etc., from all possible sources including foreign countries, for trial in various tracts.

In order to raise the efficiency of cotton cultivation, the starting in major cotton growing tracts of cotton cultivation projects on complete holdings, or preferably in villages, managed and cultivated by the cultivators themselves, according to the best system advised by the local agricultural department, and where the results of research work could be concentrated in practice and demonstrated to growers under cultivators' conditions with the improved type or types of cotton best suited to each tract was recommended. The curtailment of acreage in India as a means of raising the price of cotton was considered to be of doubtful advantage.

The Committee approved of the recommendation of the Technological Research Sub-Committee for the purchase of a pilot plant for determining the cost of production of chemical cotton from linters, waste and cheap cotton. Sanction was also provisionally accorded to a scheme for carrying out investigations at the Technological Laboratory for improving the ginning of Indian cottons involving an estimated non-recurring expenditure of Rs. 24,500 and a recurring charge of Rs. 4,600 per annum.

A new cotton breeding scheme for the production of long staple cotton for cultivation in Sind at a total cost of Rs. 2,28,700 over a period of 5 years was also provisionally sanctioned.

* * *

Botanical Society of Bengal.—The third annual meeting of the Society was held on February 25 at the Botanical Laboratory, Calcutta. Prof. S. C. Mahalanobis, President of the Society, took the Chair.

A Botanical Exhibition and Conversazionne had been organised.

The following were elected Office-bearers for the coming year:—*President*: Prof. S. C. Mahalanobis; *Vice-Presidents*: Prof. S. P. Agharkar, Prof. S. C. Banerji, Dr. K. P. Biswas, Prof. S. R. Bose; *Hon. Treasurer*: Dr. S. R. Sen Gupta; *Hon. Auditors*: Mr. P. K. Bose, Dr. A. N. Mitra; *Hon. Secretaries*: Dr. J. C. Sen Gupta and Mr. S. N. Banerji.

A resolution requesting the Government of Bengal to reprint Prain's *Bengal Plants* was adopted.

Lt.-Col. Chopra, I.M.S., delivered an address on the "Role of Botany in Pharmaceutical Medicine".

* * *

The All-India Institute of Hygiene and Public Health.—The Annual Report of the above Institution for the year 1937 which we

received a few weeks ago, is an interesting and valuable document, portraying its activities in the several fields of public health and research covered by the Institution. During the four years of its existence, the Institute has produced four batches of diplomats in public health, most of whom have found ready employment in State service.

Research of a fundamental character on cholera vibrios has been carried out by Dr. Linton and his colleagues; fresh light has been thrown on the ætiology of epidemic dropsy. Black water fever therapy is being successfully developed; this should "inspire confidence amongst those who are destined to extend the bounds of human civilisation into tropical jungles".

Investigation of about 900 maternal deaths in Calcutta revealed that maternity need not be attended with any risk, if the expectant mother is carefully looked after and trained midwives are in attendance. Most of the Public Health problems are connected with the economic prosperity of the community and the effective adoption of the results of research persued at the Institute, will entail the expenditure of large sums of money, which the government should be prepared to provide if the community should ever reap the benefits of these researches.

* * *

Statistical Testing of Business-Cycle Theories.—Volume I. A Method and its Application to Investment Activity, by J. Tinbergen. The Economic Intelligence Service of the League of Nations has just published a Volume entitled "Statistical Testing of Business-Cycle Theories —A Method and its Application to Investment Activity," by J. Tinbergen.[1] According to a recent note issued from the Information Section of the League of Nations, this is the first instalment of a short series of publications to follow up Professor Gottfried von Haberler's scholarly work, "Prosperity and Depression," which was published by the Economic Intelligence Service in 1937. In that book Professor von Haberler, who is now at Harvard University, examined the different existing theories concerning the nature of what is currently termed the trade cycle, with a view to ascertaining what they had in common, the points at which differences arose, and in so far as possible the causes of those differences. Its publication constituted the completion of the first stage of an enquiry into the nature and causes of the trade cycle that had been begun some years earlier. The second stage was to consist of an attempt to confront those theories with the historical facts, to subject them, in so far as those facts can be quantitatively expressed, to statistical analysis, or, in so far as they cannot be so expressed, to compare them with the recounted records of the past.

The Volume which has just been published has been prepared by Professor J. Tinbergen, who was seconded for this purpose from the Central Statistical Bureau of the Netherlands. It forms an introduction to the work which has since been begun and which is concerned with the statistical testing of the assumptions and propositions that are essential to the main business-cycle theories. The primary object of the Volume is to explain the method which, subject to any suggestions that may be received, it is proposed to employ for the statistical testing of trade cycle theories. The description of the method known as multiple correlation analysis is followed by three examples of its application to economic phenomena. These examples relate to fluctuations in total investment, residential building and net investment in railway rolling stock. The results obtained in the elaboration of these three examples, as the Director of the Economic Intelligence Service of the League of Nations remarks in a preface, must prove of interest to students of the trade cycle. They are, however, only incidental to the primary objects of M. Tinbergen's work, which are to explain the system of statistical analysis employed and to arouse discussion concerning it that may prove of value in the execution of the work.

* * *

League of Nations: Health Organisation.—Dr. L. W. Rajchman, Director of the Health Section since its inception in 1921, resigned his office on January 31st. Dr. R. Gautier has been placed temporarily in charge of the section.

On the recommendation of the Bogotá Pan-American Sanitary Conference, the Bacteriological Institute of Buenos Aires, has been recognised as the centre for the distribution of international biological standards on behalf of the Health Organisation, to the central laboratories of South American Countries. Uptil now this was being done by the National Institute for Medical Research, London, and the State Serum Institute, Copenhagen.

* * *

Medicinal Plants in Himalayas.—Samples of valuable commercial medicinal plants from Kashmir Hills have recently been acquired for exhibition in the Industrial Section of the Indian Museum (Botanical Survey of India). These include, *Atropa Belladona,* which grows in the Himalayan ranges at altitudes of 6,000–12,000 feet; Indian Rhubarb, *Rheum emodi* growing wild in various parts of Nepal and Sikkim at altitudes of 4,000–12,000 feet; *Podophyllum emodi* or 'Papra', a small herbaceous plant growing wild from Sikkim Himalayas to N.W. Frontier; *Artemisia maritima,* the source of the valuable drug Santonin, found growing in Kurrum valley and in Kashmir; *Hyoscyamus niger* reported as growing wild in Kashmir Hills and recently brought under cultivation, contains the required percentage of alkaloid; *Valeriana Wallichii* grows wild in the mountain ranges extending from Kashmir to Bhutan at altitudes ranging from 4,000 to 12,000 feet; *Digitalis purpurea,* commonly known as foxglove, extensively cultivated in Darjeeling and Kashmir Hills; *Juniperus communis* and *J. macropoda,* the oil from the berries of which, is of importance in pharmaceutical trade, found in plenty in the western Himalayas; *Plantago ovata* or 'Isabghul' which grows in lower hills as well as in Punjab and Sind plains; *Colchi-*

[1] League of Nations, Ser. L.o.N.P., 1938, II, A. 23, 164 pages. Price: 3/6 *d.*; $0·90.

cum luteum extensively found in the Western temperate Himalayas, forming a good substitute for the official drug, the corms of *Colchicum autumnale* not reported as yet from any part of India; and *Aconitum chasmanthum*, which grows abundantly in Kashmir, regarded as a good substitute for the imported drug obtained from *Aconitum napellus*.

* * *

Recent Advances in Insect Embryology.—At the ordinary monthly meeting of the *Royal Asiatic Society of Bengal*, Calcutta, held on Monday, April 3, Dr. M. L. Roonwal presented a paper on insect embryology. The first part of the paper is devoted to a brief historical sketch of the development of insect embryology from early times. "This is followed by an account of some of the recent advances on the subject, the more important items dealt with being: the theory of multi-phased gastrulation; the 7-segmental nature of the insect head; the function of the pleuropodia; the mechanism of blastokinesis; the classification of insectan genital cells; and finally, the origin of some of the body sclerites, *viz.*, the labium and the pleuron. Some embryological problems whose study is likely to give fruitful results are described. A complete and classified bibliography of insect embryology is appended."

* * *

The Detection of Toxic Gases in Industry: Nitrous Fumes.—The detection of nitrous fumes is the subject of a further leaflet issued by the Department of Scientific and Industrial Research in the series dealing with the detection of poisonous gases produced in industrial processes ("Methods for the Detection of Toxic Gases in Industry, Leaflet No. 5, Nitrous Fumes" published H.M. Stationery Office, 3*d.* net).

The situations in which nitrous fumes may be encountered in dangerous concentrations include ammonium nitrate works, celluloid works, dyestuffs works, explosives works, nitric acid works, nitro-cellulose paint, lacquer and leather cloth works, photographic film works, sulphuric acid works (chamber process).

They are also encountered in electro-plating, engraving, metal cleaning and photogravure processes, and are formed during oxy-acetylene welding, particularly when an oxy-acetylene flame plays on cold steel in a confined space. They have caused fatalities during the heat treatment of metals in molten nitrates.

Nitrous fumes, the leaflet states, are extremely dangerous on account of their insidious character. There may be, and generally are, no immediate effects and, therefore, it is impossible to foretell the serious consequences that may result from the inhalation of these fumes. A workman, unaware that he has inhaled the fumes, continues at work, often remaining well until after he has returned home. Some hours later he becomes restless with a dry cough and shortness of breath. These symptoms increase, accompanied by a frothy sputum tinged with blood. If appropriate treatment is not applied, death follows from œdema (waterlogging) of the lungs.

Concentrations stronger than 1 in 10,000 are frequently fatal if breathed for more than a few minutes. It is, therefore, most important to note that a concentration which is dangerous to inhale for even a short time may be hardly noticeable, because no disagreeable symptoms may be produced. For this reason any atmosphere in which nitrous fumes are noticeable either by smell, irritation, or colour, should be regarded as dangerous.

The chemical test described in the leaflet is sufficiently sensitive to be readily capable of detecting a concentration of 1 part in 100,000.

The standard method of test which has been developed depends on the Griess-Ilosvay reaction. It is carried out by drawing the atmosphere under test by means of a hand pump through a tube containing the reagent (a mixed solution of α-naphthylamine and sulphanilic acid in acetic acid) until a rose-pink colour of standard depth is reached. From the number of strokes of the pump required to produce the standard colour, the concentration of nitrous fumes present can be obtained by reference to the table given in the leaflet. The leaflet contains detailed instructions for carrying out the test and for the preparation of the standard coloured solution required.

* * *

A Summary of the World Literature and a Critical Survey of the Mechanical Tests employed in testing Bituminous Road Materials is presented in a report recently issued by H.M. Stationery Office (the Mechanical Testing of Bituminous Road Materials, Special Report No. 1). As the intensive application of scientific methods to road research is a relatively recent development, engineers and surveyors will find this volume of great interest as a guide to the manner in which the mechanical testing of bituminous materials has been developed up to the present time.

It includes a bibliography of 137 references.

* * *

Prof. K. S. Krishnan, Mahendralal Sircar Professor of Physics, Indian Association for the Cultivation of Science, Calcutta, has been invited to present a paper on 'the application of magnetism to the study of crystallised media and molecular symmetry' at the Study Meeting on "Magnetism" organised by the *Institute of International Co-operation* in collaboration with the *Service Central de la recherche scientifique de France.* The meeting will be held at Strasbourg during May 21–25; the subjects will be discussed under the following heads: (1) Paramagnetism; (2) Ferromagnetism; and (3) Magneto-optics. *The International Institute of Intellectual Co-operation* has so far arranged four study meetings. The last meeting on "Fundamental Principles and Methods of the Mathematical Sciences", was held at Zurich in December 1938.

Professor Krishnan has also received an invitation to take part in the meeting of the Deutschen Bunsen-Gesellschaft to be convened at Danzig from 18–20 May to discuss problems in "Magnetochemie".

Professor Krishnan will be sailing from Bombay on April 29, and will return to India early in July.

* * *

The Willam Prize for 1938 has been awarded by the Council of the Iron and Steel

Institute, London, to **Mr. D. V. Krishna Rao**, Iron and Steel Works, Bhadravati. This award is made to the author of a paper of a "practical character judged by the Council to be the best paper of that character presented to the Institute and accepted for publication at the Annual or Autumn meeting each year". Mr. Rao's paper which has received the award is entitled "The New Steel Plant of the Mysore Iron and Steel Works, Bhadravati, India". The paper gives a brief account of the new basic open-hearth furnace installed at Bhadravati in great detail. The principal constructional features, the leading dimensions of the furnace and the various improvements effected in the refractory lining are given. Full details of the producer-gas plant, valves, ladles and ingot moulds are also furnished. The method of teeming, rimming and killed steels is described in detail. The special procedure adopted when teeming killed steels is claimed to give very sound ingots and results in a very small percentage of rejections at the mills. A brief description of the reheating furnace and the rolling mills attached to the steel plant, together with the principal operating features and the extent of the rolling programme, completes the paper.

The value of the award is £100.

* * *

Journal of Endocrinology.—A new journal devoted to the publication of communications which "advance knowledge concerning the internally secreting glands, the mode of their actions, and the disorders of their functions", will be published under the Editorship of Prof. E. C. Dodds, by the Oxford University Press. The Journal will be published quarterly in the first instance, in the months of January, April, July and October. The first issue is expected to appear this month.

Before deciding on the publication of this new journal, the members of the promoting committee consulted the Editorial Boards of a large number of British Journals, who, without exception, favoured the foundation of such a journal. The subscription rate for each volume will be 30*sh.* Papers intended for publication should be submitted to the Editors of the Journal, Courtauld Institute of Biochemistry, Middlesex Hospital, Mortimer Street, London, W.1.

* * *

Andhra University.—Dr. C. R. Reddy has been re-elected Vice-Chancellor of the Andhra University for a further term of 3 years.

The Academic Council of the Andhra University has approved the proposal of the Syndicate to provide instruction in courses leading to M.Sc. degree in Applied Physics. The course will be opened in the Jeypore Vikrama Deo College of Science and Technology, from July 1939.

The Senate unanimously approved the proposal of the Syndicate that "the Honorary Degree of Doctor of Science, D.Sc., be conferred on Sonti Kamesam, M.E. (Hons.), M.I.E., in recognition of his distinguished researches in Timber Technology and Forest Produce generally and their economic utilisation".

The Medical Council of India, at its meeting held on April 3–4, decided *inter alia* to recognise the M.B.B.S. degree of the Andhra University.

* * *

University of Mysore.—I. LECTURES: The following lectures were delivered under the scheme of Extension Lectures during the month:—(1) Mr. P. Kodanda Rao, M.A., Servants of India Society, Poona, on "A View of Civilization" in English at Bangalore. (2) Mr. V. Venkatachar, M.A., B.COM., Assistant Director (Commerce) and Secretary, Board of Industries and Commerce, Bangalore, on "The Foreign Trade of Mysore" in Kannada, at Davangere and Shimoga. (3) Mr. D. S. Mallappa, M.L.C., Merchant, ex-President, Tumkur District Board, and Director of the Bank of Mysore, Ltd., Tiptur, on "Social Legislation" in Kannada, at Bangalore and Mysore. II. INTER-UNIVERSITY BOARD: The Vice-Chancellor has been elected Chairman of the Inter-University Board for the year 1939–40.

Announcements

Sugar Technologists' Association of India.—The next convention of the Association will be held sometime either in September or October, 1939.

Those desirous of communicating papers for the convention are requested to get into touch with the Secretary, Sugar Technologists' Association, Cawnpore. Papers should reach the Secretary before the end of June.

Papers dealing with original researches, new designs, calculations and new application of known processes and equipment are naturally those which will receive first consideration. But besides these, papers on subjects of technical and general interest to the industry will also be welcomed. Some of the subjects which may be specially mentioned as suitable for this purpose are cane agriculture, cane diseases and pests, fixation of sugarcane prices, sugar manufacturing processes, sugar engineering, utilization of bye-products, fuel consumption, chemical control, and fiscal and economic aspects of the industry.

Papers dealing with the engineering side of the Industry are specially requested and it is hoped that gentlemen connected with the designing, manufacture, erection and maintenance of machinery and equipment for the sugar industry will come forward with papers which will focus attention on recent developments in this important section of the Industry.

13th International Acetylene Congress.—Further details regarding the 13th International Congress of Acetylene, Oxy-Acetylene Welding and allied industries, are now available. The Congress will be held in Münich from October 2nd to 6th, 1939, under the protectorship of Prime Minister Field-Marshal-General Hermann Göring. The inaugural ceremony will be held on Monday October 2, in the banquet hall of the German Museum, Münich. Excursions have been arranged for the Münich October festivities, to the Eibsee and to the Zugspitze; a two-days' trip through the Alps to Innsbruck and Salzburg has also been organized. In connection with the Congress there will be a

Technical-Scientic exhibition covering the whole field of the Congress and subdivided into various sections.

All communications intended for being presented at the Congress must reach the Congress Office, Berlin-Friedenau, Bennigsenstrasse 25, on or before June 15th, 1939.

Imperial Mycological Conference.—The provisional programme of the Conference which will be held at the Imperial Mycological Institute, London, is now available. The Conference will be held from September 18th to 23rd.

The subjects for discussion will include: Quarantine in relation to plant diseases, biological methods of evaluating the efficiency of fungicides, virus diseases of economic plants, soil deficiency diseases, bacterial diseases of stone fruits in the Empire. Short summaries of papers offered should reach the Director, Imperial Mycological Institute, London, before the end of July.

The **Eighteenth International Congress of Anthropology and Prehistoric Archaeology** and the Eighth Session of the International Institute of Anthropology will be held at Istanbul, Turkey, from September 18–25, 1939. Communications regarding the Congress may be addressed to Prof. Muzaffer Göker, Dean of the Faculty of Languages, History and Geography, Ankara, Turkey, who is the General Secretary of the Congress.

* * *

We acknowledge with thanks, receipt of the following:—

"Agriculture and Live-Stock in India," Vol. 9, Pt. 1.

"Journal of Agricultural Research," Vol. 57, No. 12 and Vol. 58, Nos. 1 and 2.

"Agricultural Gazette of New South Wales," Vol. 50, Part II.

"The Philippine Agriculturist," Vol. 27, Nos. 9 and 10.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, Nos. 1 and 2.

"Nagpur Agricultural College Magazine," Vol. 13, No. 3.

"Indian Journal of Agricultural Science," Vol. 9, Part I.

"L'Agricoltura Coloniale," Vol. 33, No. 1.

"Journal of the Royal Society of Arts," Vol. 87, Nos. 4496–4504.

"Biochemical Journal," Vol. 33, Nos. 1 and 2.

"Journal of the Institute of Brewing," Vol. 45, No. 3.

"Berichte der deutschen Chemischen gesellschaft," Vol. 72, No. 2.

"The Calcutta University Journal," Vol. 1, No. 2.

"Chemical Age," Vol. 40, Nos. 1022–29.

"Comptes Rendus (Doklady)," Vol. 22, Nos. 1 and 2.

"Journal of Chemical Physics," Vol. 7, Nos. 1, 2 and 3.

"Journal of the Indian Chemical Society," Vol. 15, Nos. 11, 12 and Vol. 16, No. 1.

"Journal de Chimie Physique," Vol. 35, No. 12 and Vol. 36, No. 1.

"Experiment Station Record," Vol. 80, No. 1.

"Transactions of the Faraday Society," Vol. 35, Nos. 214 and 215.

"Indian Forester," Vol. 65, Nos. 2, 3 and 4.

"Indian Forest Records," Vol. 1, No. 3 (Botany) and Vol. 5, No. 1 (Entomology).

"Forschungen und Fortschritte," Vol. 15, Nos. 4–9.

"Genetics," Vol. 24, No. 1.

"Calcutta Medical Journal," Vol. 35, Nos. 3 and 4.

"American Museum of Natural History," Vol. 43, Nos. 2 and 3.

"Mathematics Student," Vol. 6, No. 3.

"Bulletin of the American Meteorological Society," Vol. 19, No. 10.

"Journal of Nutrition," Vol. 17, No. 2.

"Nature," Vol. 143, Nos. 3613–20.

"Indian Journal of Physics," Vol. 12, Part II.

"Canadian Journal of Research," Vol. 16, No. 12.

"Proceedings of the Royal Society of Netherlands," Vol. 41, No. 9.

"Proceedings of the Royal Irish Academy," Vol. 45, Section A, Nos. 1, 2, 3 and 4 and Vol. 45, Section B, Nos. 2, 3, 5 and 6 and Index to Vol. 44.

"Journal of Research (National Bureau of Standards)," Vol. 21, No. 4.

"Lingnan Science Journal," Vol. 18, No. 1.

"Sky", Vol. 3, Nos. 4 and 5.

"Indian Trade Journal," Vol. 132, Nos. 1703–11.

Catalogues

"Cambridge Spring Books," 1939 (Cambridge University Press, London).

"New Books, Spring," 1939 (Edward Arnold & Co., London).

"Varlag von Gustav Fischer in Jena," No. 1 (February 1939).

"Catalogo Generale delle Publicazioni," 1907–1938 (Instituto Agricolo Coliniale Italiano).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

March 1939. SECTION A.—S. S. PILLAI: *On* v(k). P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part VII. Position of the glucose residue in Gossypitrin.*—The constitution of Gossypitrin has been established as the 7-glucoside of the flavonol Gossypetin. S. RAMACHANDRA RAO AND S. ARAVAMUTHACHARI: *The Magnetic Susceptibility of Mercury and of some Dilute Alkali Amalgams.*—From the observed susceptibility value of −33·3 for mercury in the liquid state, it is suggested that the mercury atoms exist in the liquid as divalent ions Hg++. In the dilute amalgams, Li caused an increase in diamagnetic susceptibility and the other alkalis a decrease. It is suggested that the alkali atoms are dispersed as single atoms at low concentrations, and double atoms at relatively larger concentrations. S. CHOWLA: *A Definite Integral.* L. SIBAIYA AND T. S. SUBBARAYA: *Zeeman Effect of Hyperfine Structure in Intermediate Fields.*—The green line Hg I λ5461Å has been studied at field strengths up to 4000 gauss. The results show a good agreement with theory both as regards separations as well as intensities. L. SIBAIYA: *On the Self-Reversal of Spectral Lines.* S. BHAGAVANTAM AND T. VENKATARAYUDU: *Raman Effect in Relation to Crystal Structure.*—A theory of the normal oscillations of crystal lattices is presented and the normal modes of oscillations of some typical crystal lattices are worked out. S. RANGASWAMI AND T. R. SESHADRI: *Synthetic Experiments in the Benzo-pyrone series. Part I. Synthesis of Karanjin-α-Carboxylic Acid.* N. JAYARAMAN: *The Cause of Colour of the Blue Quartzes of the Charnockites of South India and of the Champion Gneiss and other Related Rocks of Mysore.* M. DE HEMPTINNE AND C. MANNEBACK: *Raman Effect and the Potential Function of the Ethylene Molecule.*

March 1939. SECTION B.—D. V. BAL AND S. K. MISRA: *A Study of the effect of different types of rations on the quality of milk, milk yield and the general condition of milch buffaloes.*—Cotton seed significantly affects the characteristics of the butter fat by increasing its melting point, and by lowering the proportion of the volatile water-soluble and insoluble fatty acids contained in it. V. S. ABHYANKAR, W. V. KOTASTANE AND N. NARAYANA: *The Proteins of Bajri* (Pennisetum typhoideum).—The nitrogen distribution of prolamin and total globulin and its two fractions globulin-A and globulin-B have been studied and their essential amino acids determined. B. N. SINGH AND M. L. MEHTA: *Studies on Physico-Chemical relations of Soil and Water—I. Water retentive force of soil as influenced by chemical fertilisers.*—The effects of ammonium sulphate (N), potassium sulphate (K) and double superphosphate (P), singly and in combinations (total 8 treatments) on the water retentive force of the soil at different moisture contents have been recorded. C. SURYAPRAKASA RAO: *The Myxophyceæ of the Bihar Province, India—I.*—Twenty-five forms have been recorded and out of these, three varieties and three forms are new.

Indian Association for the Cultivation of Science: (*Proceedings*, 21, *Part* 5)

November 1938.—P. KOTESWARAM: *Dissociation in sulphuric acid with temperature.* SUDHENDU BASU AND A. T. MAITRA: *Thermal coefficient of Rocksalt by X-ray reflection.* MOHINIMOHAN GHOSH: *Dynamics of the pianoforte String and the Hammer, Part I (Hard hammer).* S. K. MUKERJI: *On the Hyper-fine structure and analysis of some complex Lines in the first spark spectrum of arsenic in the Ultra-violet Region.* SARAJUPRASAD GHOSH: *Dispersion, Absorption and Polarisation Curves for Radio-wave propagation in the Ionosphere.* JAGANNATH GUPTA: *The origin of low frequency Raman lines in Solids.* J. N. BHAR: *Stratification of the Ionosphere.*

Indian Chemical Society:

December 1938.—A MUKHERJI: *The Vitamin B Complex in Toxic Conditions.* K. MITRA: *Nutrition Studies in Bihar, Part II. Chemical Composition of some Local Edibles.* T. N. MEHTA AND V. B. THOSAR: *The Reaction of some Aromatic Diamines with Ethyl Malonate.* PRIYADARANJAN RAY AND HARIBOLA SAHA: *Complex Compounds of Biguanides with Tervalent Metals. Part V. Thiocyanates of Chromium Biguanides.* N. N. CHATTERJEE AND GIRINDRA NATH BARPUJARI: *Spiro-compounds. Part V. The formation and transformation of Spiro-compounds from* 3- and 2-*Methyl*cyclo *hexanones.* B. L. MANJUNATH AND M. S. SHANKARA RAO: *Chemical Examination of* Bragantia wallichii (*Lour.*). G. V. JADHAV AND D. R. SUKHTANKAR: *Interaction of Sulphuryl Chloride with Arylamides of Aromatic Acids. Part I.* B. L. MANJUNATH AND M. S. SHANKARA RAO: *Note on the Occurrence of Behenic Acid in the Oil from the Seeds of* Pongamia glabra, *Vent.*

January 1939.—VISWANATH SHARMA AND SALIMUZZAMAN SIDDIQUI: *The constituents of* Didymocarpus Pedicellata. *Part II. Comparative studies in the Constitution of Pedicin,* iso-*Pedicin, Pedicinin and Pedicellin.* H. KRALL: *The Tautomerism of Nitrous acid.* M. K. INDRA: *Variation of the cataphoretic velocity of silver halides in presence of different dyestuffs.* MAHAN SINGH: *Studies on Rotatory power and chemical constitution. Part IV.* BALAWANT SINGH AND SOHAN SINGH: *Potentiometric studies in oxidation-reduction reactions. Part IV. Oxidation with potassium chlorate.* KUNJ BEHARI LAL AND HANS KRALL: *The Phenylthiocarbamides. A contribution to the study of the Triad -N.C.S-. Part VIII. The Chemistry of Hector's Base and attempts towards its synthesis.* P. C. MITTER AND SHYAMAKANTA DE: *Studies in γ-Ketonic acids. Part I.* H. S. JOIS, A. KUPPASAMI AND B. L. MANJUNATH: *Isomerisation of Benzylidene Derivatives. Part I.* BAIDYANATH GHOSH: *Studies on the changes of Blood-lipoids of Normally fed and Vitamin C-deficient Guinea-pigs.*

444-39.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc. for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore

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The Indian Institute of Science

SINCE the Irvine Committee reported on the unhappy circumstances which prevailed in the Institute at the time they commenced their labours, the "atmosphere of insecurity and misery", to which they had drawn pointed attention, would appear to have worsened, if the correspondence recently published in the press is credible. In the concluding section of the report, the Committee, almost in a prophetic spirit, made the remark which is at once encouraging and disturbing, that "if given a fair trial and if operated in the right spirit, the proposals will enable the Institute to begin its semi-jubilee period with renewed hope, but if our scheme fails, it can only be through the clash of personalities beyond the remedy of any powers possessed by a Reviewing Committee". We doubt whether the Institute really suffers from any clash of personalities, but we are prepared to admit that there is almost an irreconcilable war of ideals, arising from two academic luxuries which the Institute can hardly afford. The first of them is apparently a body of elderly authorities composing the Governing Council, whose imagination has become by routine administration as rigid as perhaps their arteries on account of their advancing age: the other is a group of ardent young students and members of the staff who, inflated with noble ideals, are impatient to dash forth to win their spurs in extending the frontiers of knowledge. Any school girl who has passed her matriculation examination on common sense will tell us that the former is as dangerous a symptom as the latter is a healthy sign, for a generous enthusiasm and sterling ambition, when wisely harnessed and judiciously directed, must at all times constitute an invaluable asset for the Institute. We need hardly observe that it would be a historic case of wasted opportunity if the zeal of the young men were compelled to lie fallow or interpreted as synonymous with aggressive spirit.

We have no access to the confidential documents of the Council. No responsible officer of the Institute has disclaimed the statements made in the press, impugning the principles and policies underlying the recent proceedings of the Governing Council. Where, however, one party resorts to the press and the other remains passive, it is natural to assume that the public statements may in some measure be vitiated by exaggeration of the actual state of affairs. In spite of such dubious circumstances, it seems perfectly legitimate to offer some comments on the real issue, lurking behind this superficial and unnecessary controversy, the issue whether the affairs of the Institute are to be conducted on the basis of objective reality or on the strength of emotional convictions, whose source must at all times remain extremely suspect.

The appointment of Sir Venkataraman in the first instance as Director, and later as Professor of Physics, amounts almost to an epic episode in the annals of the Institute. Having perpetrated this act and as a necessary consequence, the Governing Council should have recognised the wisdom of taking the only logical course of inviting a number of Venkataramans to occupy the professorial chairs of other departments, so as to establish a balance of scientific power and a healthy competition among them on perfectly equal terms. If anything is clear in this complicated world, it is clear that administrators are profoundly ignorant of the modern teachings of folklore and human psychology, and failure to appreciate the truth of the maxim that an academic institution is as weak as its strongest member of the staff, inevitably led the Irvine Committee to record that they were confronted at the outset of their task with issues involving the personal relationships between the Director and the Staff, imposing upon them the undesirable necessity of investigating "the disquieting state of affairs".

On the subject of Staff the Sewell Committee reported as follows in 1931:

"Whatever developments take place in the Universities, we are convinced that with the resources at its disposal, this Institute ought always to be in a position to supply such opportunities for training as cannot be obtained anywhere else in India. This Institute shoud do what no other institution can do. It should maintain a position of pre-eminence: it should acquire a national, even a world reputation: it should become a place of reference. In order that the Institute may maintain such a reputation, two matters are in cur opinion of the highest importance. We have occasion in more than one place in this report to draw attention to the ignorance of the work of the Institute which apparently prevails. But we now propose to deal with a second factor, on which the reputation of the Institute greatly depends.

"We refer to the personnel of the Directorate, professoriate and staff. It is a well-known fact that, in more cases than one, the reputation of a University has been built up round the work of some pre-eminent man. Students are attracted by the reputation of the man under whom they hope to work, rather than by any particular virtue of the University itself. A Nernst or a Ramsay would draw men to any institution to which he happened to be attached. We are of the opinion that the chairs in the Institute should be filled by men of the highest eminence, irrespective of nationality, and we recommend therefore, that the terms of appointment be made sufficiently favourable to attract such men."

In 1936 the Irvine Committee remarked as follows on the work of certain departments:

"Some research of sound quality has been carried out, but much of it would come appropriately within the programme of investigations carried out in the Universities for a first research degree."

It is appropriate in the light of these observations to enquire whether or not the administration of the Governing Council during the five years intervening between the two Committees, had started the Institute on a process of retrogressive metamorphosis, resulting in its emergence as a University attempting work of the M.Sc. standard. It will be useful in this connection to remember that most of the scholars coming to the Institute for inspiration and guidance in higher researches, have already obtained the M.Sc. degree, and a fairly large number, the Doctorate degree of Universities enjoying a high academic reputation. Commenting on the future expansion of the Institute, the Sewell Committee observed that "students prior to their admission to the Institute have already received a high degree of training, and in many cases have been initiated into the methods of research in their Universities". Regarding the quality of training to be provided in the Institute, the Pope Committee observed that "it is highly desirable that men trained in the Institute should be eligible for appointment to the professorial staff in due course". Having these illuminating documents before them and manifestly hungering for stimulating inspiration and competent guidance, the junior members of the staff and the scholars desire the Governing Council to take appropriate and urgent steps for the fulfilment of the recommendations regarding the work of the departments and the recruitment of professors made by the authoritative Reviewing and Special Committees.

Judging by the statements published in the press, we are inclined to the opinion that the main problem, occupying the minds of scholars and the members of the staff, seems to be a determined desire to possess Nernsts and Ramsays among them, and naturally when they feel that their reasonable wish is not likely to be realised, they resort to all the constitutional methods open to them for redressing their wants. We have infinite confidence in the sincerity and good faith of the Governing Council, consisting of distinguished scientists, eminent educationists, recognised leaders of public opinion and mature administrators, who have undoubtedly the well-being and prosperity of the Institute nearest to their hearts, but, all the same, having regard to the uniformly impartial treatment accorded to the authoritative pronouncements of all the Committees, respecting the status of the Institute, the qualifications and the breadth of outlook on the part of professors and the range, and quality of scientific work to be initiated and pursued by the superior staff and scholars, we are afraid we cannot rely too confidently on the stability of the mental institution of the Council. It is a well-known psychological fact that almost as a rule when we are compelled to be sensible about working actions, our mind does not necessarily ensure during the same period perfect rationality. It is equally true that administration is a human invention whose treachery is capable of making the admitted virtues of any system a convenient excuse for indulging its vices; for the boldest among us must often shrink from the mental discomfort which is the only reward accruing from our capacity to face truth, though admittedly one of the greatest virtues. We emphasize that the central aim of the Governing authorities of the Institute should definitely tend to reduce the unreasoning fear in its alumni and the unconscious tension in the members of the staff, and this can be achieved only if they give a high-minded attention to all their wants, leaving none of them in an acutely explosive state.

Prior to 1931, the existence of the Indian Institute of Science was known only to the favoured professors and students working in its departments, and probably to those distinguished members who sat in the Governing bodies. Since that date, however, its affairs have formed the subject of acrimonious discussion in the press, calculated to driving the intelligent public almost into a psychopathic state. Both are unfortunate. We are convinced that the only way of restoring peace and harmony so essential for orderly progress and of removing from the atmosphere of the Institute fear, suspicion, discontent, jealousy and all other unfortunate forms of emotional excesses, with which it is now charged, is to reorganise the entire constitution. We make no claim to being a prophet, but we must emphasize that the path of wisdom lies in the clear recognition of the spirit of the times and in the open-handed satisfaction of its reasonable demands.

We attribute the failure on the part of the Institute to fulfil the great intentions of its Founder, we trace the adverse remarks of the Reviewing Committees on the work of its departments and we assign all the later unfortunate developments in its premises, to the divided responsibility and the defective constitution under which the Institute has been labouring for the last quarter of a century. The Governing Council, consisting of exceptionally clever and good men, have been, in a spirit of absolute self-sacrifice, devoting a few hours in the year, snatched out of their pressing professional life, to the consideration of the affairs of the Institute, and it must not be surprising and unreasonable if their view-points and decisions should diverge from those of people who actually live these affairs all the laborious days of the year. We seem to forget that the ardent observations of the Reviewing Committees are as much applicable to the administration of the Governing Council, as they must be to the work of the staff. If the two spheres constitute a unitary concept of the life and activity of the Institute, it is not quite clear to our minds why the Reviewing Committees do not touch the Governing Council, and why they select only the members of the staff for the exercise of their tender solicitude. Is the Governing Council part or is it not a part of the Institute organisation? Is the Governing Council above the Committee's purview, because it is a composite body of elected and nominated members rendering voluntary service. To whom are the elected members responsible,—to their constituencies or to the Central Government? What is the constitutional, financial or academic relationship of these constituencies to the Institute? What interests do the elected members represent on the Governing Council? Do the Universities which now elect members to the Governing Council purport to prescribe the academic standards or to exercise vigilance over the research work of the Institute? Is there any political, social or academic institution whose affairs are entrusted to a Governing body, some of whose members represent definite interests and others, only general interests. Where the responsibilities of the group of members composing a single administrative unit belong to different constitutional orders, the fundamental principles of the organisation cannot be sound. We are of the opinion that this want of homogeneity in respect of the responsibilities of the members has been, for the past twenty-five years, operating as a conflicting and inhibiting factor, and that if the Institute is emancipated from this fatal anomaly it may start on a new life of hope and activity. The students and the staff are the only real and

legitimate custodians of the destiny of the Institute. It is their duty to fulfil the intentions of the Founder. They must enjoy the unfettered freedom to direct and influence the fate and fortune of the Institute. If, however, the concerned authorities do not see the need for altering the complexion of the constitution, they should have at least the fortitude of mind to face the probability of the next Reviewing Committee assessing the work of the Institute as falling within the programme of a glorified First Grade College.

We now proceed to indicate in broad outline the general changes which might profitably be introduced in the constitution for securing stability and stimulating cheerful co-operative effort in the Institute. We must, however, premise that the success of the experiment we propose depends on one very big condition, *viz., that the Professors should be as described by the Sewell Committee. In other words the Institute in the superior services should be peopled by scientific men of the eminence of Hopkins, Haber, Bergius, Robinson, Karrer, Hans Fischer, Debye, Armstrong, Morgan, Langmuir, Ruzicka, Kuhn, Aston, Bragg and Haworth.*

I. Management

The Visitor should be the final and absolute authority in all matters relating to the Institute.

The general management of the Institute should vest in the Institute Council, consisting of Professors, who should be its *ex-officio* members; one Reader, one Assistant Professor, one Lecturer and one student member, elected by their respective colleagues. The elected members should hold office for two years. The Rector of the Institute should be the Chairman, and the Registrar its Secretary.

The functions and duties now exercised by the Governing Council should be transferred to this new body.

The Institute Council should meet once a month and the minutes of the Proceedings should be furnished to the Government of India, the Tata Family, the Government of Mysore and such other Indian States and Provincial Governments contributing an annual subvention of Rs. 10,000.

II. Commission of Inspection

The administrative duties of the Institute Council and the academic work of the departments should be subject to annual review by a Commission of Inspection, appointed by the Central Government on the following basis:

1. Commissioner of Education—*Chairman.*
2. A representative of the Tata Family.
3. A representative of the Government of Mysore.
4. A representative of the Court.
5. A representative of the Inter-University Board.
6. A representative of the Federated Chambers of Industries and Commerce.
7. The President of the Court.
8. The Rector of the Institute should be the assessor to the Commission.

The inspection report should be submitted to the Government of India, the Tata Family, the Mysore Government, the President and members of the Court, to the members of the Institute Council, to the members of the Standing Committee and to all the Indian States and Provincial Governments making an annual subsidy of Rs. 10,000.

III. The Court

The Court should be reconstituted as follows: (1) Two nominees of the Visitor; (2) Two nominees from the Government of India; two from the Tata Family, two from the Mysore Government; (3) One nominee from each of the Indian States and Provincial Governments contributing Rs. 5,000 and more; (4) One nominee from each of the Industries and Commerce endowing a chair or paying an annual grant of Rs. 2,000; (5) One nominee from each of the Universities contributing Rs. 1,000 annually; (6) All the Professors of the Institute; (7) One elected Reader, Assistant Professor, Lecturer and Student; (8) Two members distinguished in Science and Industries or who have rendered meritorious public service, elected separately by (*i*) The Professors, (*ii*) The Readers, (*iii*) The Assistant Professors, (*iv*) The Lecturers and (*v*) The Students.

The Court should elect its own President. It should meet once in the year. Its functions and duties should remain as at present.

IV. The Standing Committee

The Court should constitute a Standing Committee from among its members which should assume the duties now discharged by the Finance Committee in addition to those assigned to it by the Court. The Standing Committee should consist of twelve members, three of whom representing the Central Government, the Tata Family and the Mysore Government should be *ex-officio*. The Rector of the Institute should act as assessor and the Registrar, as Secretary. The Standing Committee shall meet once in every quarter. The President of the Court shall be *ex-officio*, Chairman of the Standing Committee. The staff of the Institute shall not be eligible for election to the Standing Committee.

V. The Senate

The Senate should consist of Professors, Readers, Assistant Professors, two representatives of the junior members of the staff and two representatives of the students. The Rector should be the President and the Registrar its Secretary.

It should be competent for the Senate to re-examine the intentions of the Founder of the Institute in the light of interpretations put upon them by the Reviewing Committees. The re-orientation of the academic policy of the Institute should be included among the other functions and duties of the Senate. All decisions of the Senate should be subject to reconsideration by the Institute Council and confirmation by the Standing Committee. Proposals for inviting Visiting Professors and for exchange of Professors should fall within the purview of the Senate, subject to scrutiny by the Institute Council and final approval by the Standing Committee.

VI. Staff

The staff of the Institute should consist of Professors, Readers, Assistant Professors and Lecturers.

1. *Professors.*—The Professors should be distinguished alike for their character and for their scientific eminence whose achievements have been recognised by Learned Bodies like the Royal Society of London. Their salary and terms of appointment should be determined by the Standing Committee acting in conjunction with the Institute Council.

2. *Readers.*—Readers should be in charge of specialised subdivision of subjects forming corridors of the main departments. Readerships should be occupied by men of outstanding eminence.

3. *Assistant Professors and Lecturers* should be appointed on the basis of their approved capacity for research and for guiding students in the investigation of scientific problems in pure and applied branches.

4. The appointment of distinguished specialists as Visiting Professors and the institution of a definite scheme for exchange of Professors, Readers and Assistant Professors should form the settled and clear policy of the Institute.

5. The administrative head of the Institute should be designated Rector. He should be elected for the post by the Senate. The Rector shall hold office for a term of two years. Professors should be eligible for election.

6. The Rector should be assisted by a Bursar who should also be elected by the Senate for a term of two years from among the Professors and Readers, whose duties will be to look after the finances of the Institute, and to act for the Rector during his absence from the Institute. The Rector should establish sympathetic contacts with industries, commercial organisations, Indian States and Provincial Governments and Universities and official Research Centres and Scientific Surveys for co-ordination of work and for enlisting financial support. The Rector and Bursar should be eligible for re-election.

VII. Selection of Staff

The Selection Committees should be constituted by the Institute Council subject to the approval of the Visitor. The panel of names (the Selection Committees need not necessarily confine the choice to applicants, but should enjoy the power of inviting those who may feel delicate to apply), submitted by the British and Indian Committees should be first scrutinised by the Institute Council at a special meeting

called for the purpose. A further choice should be made by the Institute Council, which together with the original recommendations should be forwarded to the Standing Committee, with such observations as the Institute Council might desire to offer. The Standing Committee should make the final nomination for the approval of the Visitor, at a special meeting convened for the purpose, and the nomination should be accompanied by a report prepared by the Chairman. It should be competent for the Institute Council to prescribe the terms of advertisement, and all the subsidiary matters relating thereto, including the date for summoning the meeting of the Standing Committee in order to avoid undue delay. The appointment of Readers should follow the same procedure. The nominations of the Standing Committee should be subject to approval of the Visitor.

The procedure for the appointment of Assistant Professors should be similar to that followed in the case of Professors, except that the authority of selection should vest in the Council and the Standing Committee being invited to approve the action of the Council. The Institute Council should have the authority to appoint Lecturers either after advertising the posts or by direct recruitment from among the senior students.

VIII. Students

The Senate should prescribe the qualifying test for admission of students to the different departments. Their number in each department should be prescribed. Universities contributing Rs. 1,000 should have the power to select their own students. Provincial Governments and Indian States and Industries making a grant of Rs. 5,000 and more should also enjoy the privilege of nominating their students. Where, however, such nominating bodies are non-existent, the Senate should make the selection with due consideration to the interests of the Provinces.

Students should be allowed to form a Union or a Federation of their own whose main object should be the promotion of their physical and intellectual welfare. The management of hostels and sports sections should be delegated to them. They should be associated with the work of the Senate, the Court and the Council, giving them opportunities for representing their views in the field of administration of the Institute.

We are aware that the suggestions we have ventured to indicate above will offend the conservative temperament of administrators who will either smile or scoff or may even brush them aside as impractical. But few realise that the acid test of a good administration of a scientific Institution such as the Indian Institute of Science is our attitude to the students, not merely because that these young men hold in their hands the key to all future developments of the country, but because from a closer co-operation with them we can gather valuable information of our own unconscious mind. If we treat our students with greater humanity and more respect, and if we succeed in eliminating their vast charges of fear and distrust, we might hope to produce a generation better equipped for solving the problems of this complicated world.

We have offered our remarks in good faith and in a spirit of helpfulness. In our judgment the Central Government, the Tata Family, and the Mysore Government, which have the greatest stake in the well-being and prosperity of the Institute, apart from safeguarding their interest, would render distinct public service, if they jointly move for the appointment of a committee,

(1) to investigate the psychological background of the existing state of affairs,

(2) to study all the documents relating to the Foundation, including the reports of the Committee, and

(3) to examine the proceedings of the Council which either accelerated or retarded the fulfilment of the intentions of the Founder and the recommendations of the Committees.

We have no doubt that when such a Committee of Investigation draw up their report, the main features of their findings will not materially differ from what we attempted to depict.

Otto Hahn zum sechzigsten Geburtstag (8. März 1939)

AM 8. März dieses Jahres haben Chemiker und Physiker aus allen Teilen der Welt Otto Hahn zu seinem sechzigsten Geburtstag ihre Glückwunsche zum Ausdruck gebracht, in Verehrung für seine grossen wissenschaftlichen Leistungen, in Liebe und Dankbarkeit für das, was er als Mensch und Lehrer so vielen gegeben hat.

Ich bin aufrichtig dankbar, daß auch mir die Gelegenheit gegeben wird, dem Manne, mit dem mich eine mehr als dreissigjährige gemeinsame Arbeit und eine ebensolange herzliche Freundschaft und innerste Verbundenheit verknüpft, einen wenn auch verspäteten Geburtstagsgruss darzubringen.

Frau Professor Lise Meitner. Professor Otto Hahn
(Vor Dem Kaiser Wilhelm Institut für Chemie)

Otto Hahn's menschliche und wissenschaftliche Persönlichkeit sind eine untrennbare Einheit. Eine sehr lebendige geistige Intuition, ein sehr gediegenes Können, ein ausgezeichnetes und kritisches Beobachtungsvermögen, eine unbeirrbare Zuverlässigkeit und Beharrlichkeit neben grosser innerer Bescheidenheit und natürlicher Liebenswürdigkeit kennzeichnen den Menschen wie das Werk.

Schon der Anfang seiner wissenschaftlichen Laufbahn ist charakteristisch fur ihn. Als organischer Chemiker geht er im Jahre 1904—nach zweijähriger Assistententätigkeit sufällig in das Gebiet der Radioactivität bei Zincke in Marburg—nach England in das Laboratorium von Ramsay, wo er ganz aufällig in das Gebiet der Radioactivität gerät. Und bereits nach halbjähriger Arbeitszeit entdeckt er eine neue radioactive Substanz, das Radiothorium. Diese Tatsache bestimmt Hahns weiteren Lebensweg. Um das Gebiet von Grund auf kennen zu lernen, geht er 1905 zu Rutherford nach Montreal, und dieses Ausbildungsjahr an der McGill University führt ihn schon zu einer Reihe schöner wissenschaftlicher Erfolge. Neben mehreren zum Teil mit Rutherford ausgeführten Arbeiten über Reichweite und Ladung der Alphastrahlen entdeckt er in einer ganz selbständigen Untersuchung das Radioactinium.

Im Jahre 1906 kehrt er nach Deutschland zurück und beginnt seine selbständige wissenschaftliche Laufbahn im Emil Fischerschen Institut in einem kleinen, ursprünglich als Holzwerkstatt vorgesehenen Raum. Aus dieser "Holzwerkstatt" sind eine Reihe seiner schönsten Arbeiten in die Welt gegangen. Hier hat er die Substanzen Mesothorium 1 und Mesothorium 2 entdeckt, hat unabhängig von etwa gleichzeitigen Arbeiten von Boltwood beziehungsweise Marckwald das Ionium als Muttersubstanz des Radiums nachgewiesen, hat den mit der Emission der Alphastrahlen verbundenen Rückstoss entdeckt und vieles mehr.

Ende 1907 begann unsere gemeinsame Arbeitstätigkeit, die — neben zeitweiligen durch die Gebietsentwicklung bedingten getrennten Arbeitsrichtungen — sich über ein halbes Menschen leben erstrecken sollte. In diesen Jahren wurden als neue radioactive Substanzen die Körper Thorium C″, Radium C″ und Actinium C″ gefunden, eine Reihe von Untersuchungen über Betastrahlen—zum grossen Teil in Gemeinschaft mit O. v. Bayer—gemacht, die zur Auffindung der (sekundären) Betastrahlspektren führten, und es wurde das Protactinium entdeckt. Im Jahre 1912 wurden die Arbeiten aus der "Holzwerkstatt" in eine kleine radioactive Abteilung des Kaiser Wilhelm Instituts für Chemie verlegt, aus der sich im Laufe der Zeit ein weitgehend für radioactive Forschungen eingerichtetes Institut entwickelt hat mit einer dem Gebiet entsprechenden

Zweiteilung für chemisch-radioactive und physikalisch-radioactive Arbeiten. Seit 1929 ist Otto Hahn Direktor des Kaiser Wilhelm Instituts für Chemie.

In den Jahren nach dem Weltkrieg hat Hahn unter Anderem das Uran Z entdeckt, das, wie wir heute wissen, das erste Beispiel einer Kernisomerie darstellt. Und mit einer grossen Zahl von Schülern und Mitarbeitern hat er das Gebiet der angewandten Radiochemie um sehr grundlegende Ergebnisse bereichert, deren volle Bedeutung bei der heute zur Verfügung stehenden Zahl von künstlichen radioactiven Atomarten noch gar nicht zu übersehen ist. Hahn selbst hat in einem aus Vorträgen in Amerika hervorgegangenen Buch "Applied Radiochemistry" die Hauptergebnisse dieses Gebiets zusammengestellt. Und der Einleitungsvortrag "From the ponderable to the imponderable" ist ein besonders schönes Beispiel für Hahns weitumfassende Beobachtungsfreude und Beobachtungsgabe und für seine liebenswürdige menschliche Art.

Im Jahre 1935 haben wir wieder eine Zusammenarbeit begonnen, um die bei Neutronenbestrahlung von Uran und Thorium hervorgerufenen künstlichen Umwandlungsprocesse zu untersuchen, woran im weiteren Verlaufe F. Strassmann mitbeteiligt war. Diese Arbeiten hatten zur Auffindung mehrerer Umwandlungsreihen gefuhrt, wobei ein Teil der Umwandlungsproducte als Transurane charakterisiert wurden.

In den letzten Monaten haben Hahn und Strassmann bei dem weiteren Studium dieser Umwandlungsprocesse ganz neue und sehr weittragende Resultate erhalten. Sie konnten ziegen, dass sowohl der Urankern als der Thoriumkern durch das Einfangen des Neutrons nicht — wie ursprünglich angenommen — in Radium—beziehungsweise Actiniumisotope übergehen, sondern in niedrigere Kerne zerreissen. Das vermeintliche Radium ist Barium, das Actinium ist Lanthan und so weiter, und daneben entstehen als zugehörige Spaltstücke Krypton, Rubidium, Strontium und so weiter.

Hahn hat sich mit diesen wunderbaren Ergebnissen selbst das schönste Geschenk zu seinem sechzigsten Geburtstag beschert.

Mögen sich für ihn, wie bisher, so auch in Zukunft, im schönsten Sinn der Worte "Verdienst und Glück verketten".

LISE MEITNER.

Dr. A. M. Heron, D.Sc. (Edin.), F.G.S., F.R.G.S., F.R.A.S.B., F.N.I.

DR. A. M. HERON, Director, Geological Survey of India, retired on the 24th of March after a long and distinguished career. Dr. Heron joined the Department in 1906 after attaining high academic distinctions at the Edinburgh University and earlier at the Royal High School, becoming in 1935, the head of the Geological Survey of India.

Dr. Heron has been versatile in his activities and interests and was President of the Mining, Geological and Metallurgical Institute of India, President of the Geography Section of the Indian Science Congress, Vice-President of the Royal Asiatic Society of Bengal and of the National Institute, a Fellow of the Royal Geographical Society and of the Royal Society of Edinburgh. In addition to his scientific activities, he is a keen sportsman and was President of the Calcutta Rowing Club and of the Himalayan Club.

WORK IN RAJPUTANA

There has been no one who possesses such a long and distinguished record—extending over a period of almost thirty years—of continuous active field-work to his credit as Dr. Heron. The results of his field-surveys are embodied in numerous publications dealing with every aspect of the Geology of Rajputana, on which he is a noted authority. From the very inception of his geological career in India he has worked on the Archæan and other pre-Cambrian formations almost without a break. He is in fact one of the most versatile exponents of the geology of the ancient rocks of India. His association with the pre-fossiliferous rocks has indeed been so close that for the first twenty-five years of his career, Dr. Heron never saw a fossil—in the field!

The First Everest Expedition

Dr. Heron acted as Geologist to the first Mount Everest Expedition in 1921, the scientific results of which are embodied in his *Geology of the Himalaya Mountains and Tibet* and *Geological Results of the Mount Everest Reconnaissance Expedition.* It is unnecessary to enumerate here the many memoirs published by him on geological, economic and other aspects of Indian Geology.

Dr. A. M. Heron

Tavoy and Mergui

Not the least important of his contributions is the work he carried out during the Great War in the Tavoy and Mergui districts of Burma for the supply of tungsten. This work received the appreciation of the Government which it deserved.

Dr. Heron is a man of great energy which evinces itself in his insatiable desire for active field-work. It is good news that his long and varied experience will still be available, as he proposes to stay in India for some months for advisory work.

Not the least of Dr. Heron's qualities is that unique and rare sense of humour, so uncommon among scientists. Dr. Heron's retirement is greatly regretted by his colleagues and wide circle of friends, every one of whom had the highest regard for his friendship and genial personality. We wish him good luck in the enjoyment of many years of sound health, and the pursuit of scientific activities. Knowing his dynamic personality, it is impossible to believe that he would really enjoy what is conventionally known as "hard-earned rest".

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A Note on Self-Reciprocal Functions

I WILL say that a function is $\pm R_\nu$, according as it is self-reciprocal or skew-reciprocal for Hankel Transforms of order ν; that is, according as it satisfies the integral equation

$$f(x) = \pm \int_0^\infty \sqrt{xy}\, J_\nu(xy)\, f(y)\, dy, \quad (\nu > -1)$$

with the upper or the lower sign.

In a recent paper[1] I have proved the theorem: If $f(x)$ is R_ν, the function

$$\phi(x) = a^\alpha f(x a^{\alpha}) \pm \frac{1}{a^\alpha} f\left(\frac{x}{a^{\alpha}}\right),$$

where $a > 0$, $\alpha > 0$, is $\pm R_\nu$.

The object of this note is to give an easy generalisation of this theorem.

2. *Theorem I.*—If $f(x)$ is R_ν, the function

$$\phi(x) = F(a) f\{xF^2(a)\} \pm \frac{1}{F(a)} f\left\{\frac{x}{F^2(a)}\right\}, \tag{2·1}$$

where a is a constant, and $F(a) \neq 0$, is R_ν.

We have

$$\int_0^\infty \sqrt{xt}\, J_\nu(xt)\, \phi(t)\, dt$$

$$= \int_0^\infty \sqrt{xt}\, J_\nu(xt) \left[F(a) f\{tF^2(a)\} \pm \frac{1}{F(a)} f\left\{\frac{t}{F^2(a)}\right\} \right] dt$$

$$= F(a) \int_0^\infty \sqrt{xt}\, J_\nu(xt)\, f\{t F_2(a)\}\, dt$$

$$\pm \frac{1}{F(a)} \int_0^\infty \sqrt{xt}\, J_\nu(at)\, f\left\{\frac{t}{F^2(a)}\right\} dt$$

$$= \frac{1}{F(a)} \int_0^\infty \sqrt{\frac{xu}{F^2(a)}}\, J_\nu\left\{\frac{xu}{F^2(a)}\right\} f(u)\, du$$

$$\pm F(a) \int_0^\infty \sqrt{xu\, F^2(a)}\, J_\nu\{xuF^2(a)\}\, f(u)\, du$$

$$= \frac{1}{F(a)} f\left\{\frac{x}{F^2(a)}\right\} \pm F(a) f\{xF^2(a)\}$$

$$= \pm \phi(x).$$

Theorem II.—If $f(x)$ is $-R_\nu$, the function (2·1) is $\mp R_\nu$.

BRIJ MOHAN.

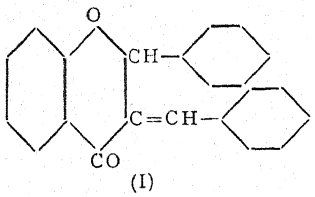
Benares Hindu University,
India,
March 18, 1939.

[1] "A few Self-Reciprocal Functions," *Proc. Physico-Math. Society of Japan*, 1934, 273–74.

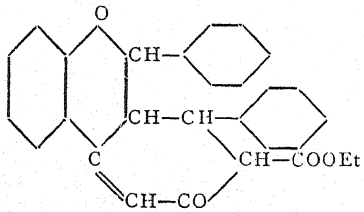
Benzylidene-Flavanones considered as Chalkones

PANSE AND WHEELER[1] have shown that Benzylidene-Coumaranones like chalkones condense with acetoacetic ester, desoxybenzoin, cyclohexanone, etc. It is now found that

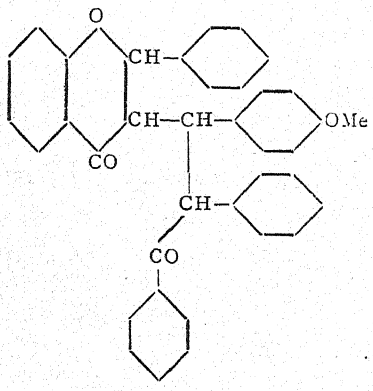
Benzylidene-Flavanones of the type (I) which contain the group -CO-C:CH- present in chalkones also undergo the above types of reactions, (II) and (III) being obtained by the condensation of the corresponding benzylideneflavanones with acetoacetic ester and desoxybenzoin respectively. The oxides (IV) and (V) analogous to chalkone oxides have also been prepared. Similar compounds have been obtained from other arylideneflavanones.



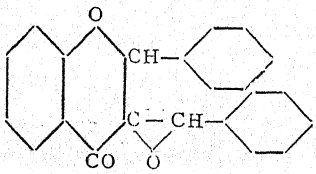
(I)



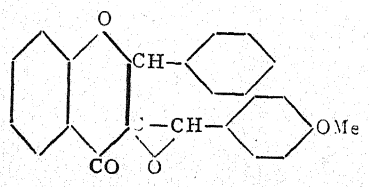
(II)



III)



(IV)



(V)

R. N. KULKARNI.
R. C. SHAH.
T. S. WHEELER.

Royal Institute of Science,
Bombay,
May 4, 1939.

[1] *Curr. Sci.*, 1938, 7, 181.

A New Synthesis of 3-Aminocoumarin

ERLENMEYER, JUN. AND BADE[1] state that salicylaldehyde does not condense with glycine to give α-amino-β-hydroxy acids by the method associated with the name of Erlenmeyer. Linch[2] has published a paper on 3-aminocoumarin; he found that salicylaldehyde and glycine did combine, in the presence of sodium acetate and acetic anhydride by Perkin's method, to give 3-acetyl-aminocoumarin, which on hydrolysis gave 3-aminocoumarin, but that the yield of the former was very unsatisfactory, being 25–30 per cent. at best. He has therefore followed a roundabout method of condensing salicylaldehyde with ethylacetoacetate (Knoevenagel) to obtain 3-acetylcoumarin, the oxime of which on undergoing the Beckman transformation, gave 3-acetylaminocoumarin and this on careful hydrolysis gave the base. The exact yield calculated on the first starting materials is not stated, but the method is said to be advantageous.[3]

We now find that salicylaldehyde and glycine, when heated directly together at 130–140° for five hours, give the 3-aminocoumarin in about 23 per cent. yield, and that yield can be further augmented by the use of a trace of pyridine. The ultimate yields obtained by suitable modifications, are exceedingly good. In two experiments the yields were 80 per cent. and the condensation of salicylaldehyde and glycine proceeded very well. Salicylaldehyde (1·5 mol.), glycine (1 mol.) and a trace of pyridine were heated together for five hours at 130–140°. The product crystallised from water melted at

130° and was identical with the 3-aminocoumarin obtained by the method of Linch.

Yield 80 per cent. of theory.

Other aldehydes are being investigated.

K. C. PANDYA.
TEJPAL SINGH SODHI.

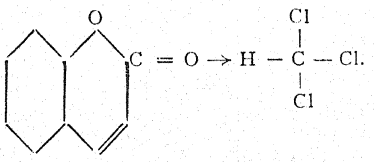
Department of Chemistry,
St. John's College,
Agra,
March 28, 1939.

[1] *Annal.*, 1904, **337**, 252–35; *C.A.*, 1905, **1**, 131.
[2] Linch, *J.C.S.*, 1912, T., 1758.
[3] Linch, *loc. cit.*

Molecular Complexes in Chloroform Solution

THAT polar solvents are capable of forming complexes with suitable solutes has been fairly well recognised and various methods have been used for detecting their formation.[1] Chloroform is said to undergo these combinations through a co-ordinate bond involving its H atom.[2]

It was recently shown by us[3] that the Raman line for the C = O group of coumarin in chloroform solution undergoes a marked shift towards the exciting line as compared with a carbon tetrachloride solution which was taken as the standard. The phenomenon was explained as due to the formation of hydrogen bond as below:—



As a result of this complex formation, in which the oxygen atom of the C = O is the donor and the hydrogen of chloroform the acceptor, the C = O bond is diminished in strength and the frequency is reduced. In the course of the extension of this work a large number of carbonyl compounds have been studied in carbon-tetrachloride and chloroform solutions. In the case of saturated ketones, acids or esters no difference between the two solvents was noticed. Obviously with these substances complex formation, if it took place at all, could not produce sufficient change to be exhibited in the Raman spectra. On the other hand, in unsaturated carbonyl compounds such as those given in the table below there was appreciable effect which could be noticed by a definite broadening of the line and a shift towards lower frequencies.

TABLE I

The C = O frequencies are given in $\Delta\bar{\nu}$

Substance	Pure state	Chloroform solutions	Carbon tetra-chloride solutions
Benzylidine acetone	1668	1653	1670
Methyl cinnamate	1712	Diffuseness towards shorter wave-lengths	1712
Ethyl cinnamate ..	1712	Do.	..
Phenyl cinnamate	1740	1722	1740
Coumarin ..	1708, 1731	1720	1742

Further work in regard to the detailed study of these is in progress. The close resemblance between coumarin and phenyl cinnamate in this respect is noteworthy and finds an easy explanation in the similarity of their structures.

G. V. L. NARASIMHA MURTI.
T. R. SESHADRI.

Department of Chemistry,
Andhra University, Waltair,
April 26, 1939.

[1] Macleod, *Trans. Farad. Soc.*, 1934, **30**, 482; Macleod and Wilson, *ibid.*, 1935, **31**, 596; Glasstone, *ibid.*, 1936, **31**, 200; Bramley, *J.C.S.*, 1916, **109**, 11–14 and 343–519; Smith and Berkmans, *Proc. Roy. Acad. Sci.*, Amsterdam, 1918, **401**, 21; Dolezalek, *Z. Physik. Chem.*, 1910, **71**, 191.
[2] Walter Gordy, *Nature*, 1938, **142**, 831.
[3] Murti and Seshadri, *Proc. Ind. Acad. Sci.*, 1938, **8**, 519.

Vitamin C in Pulmonary Tuberculosis

PHYSIOLOGICAL properties of Vitamin C such, among others, as its action on vascular permeability, its role in intoxication and in tissue respiration and its action on formative cells, suggest its application in Pulmonary Tuberculosis therapy. Some useful work has already been done in this field. A comprehensive study on the relation between Vitamin C and pulmonary tuberculosis is being carried on in this Department by Dr. S. K. Roy and the results already obtained are encouraging.

A study of the urinary excretion of Vitamin C by the method of Harris and Ray[1] as later modified,[2] proved that the system is highly unsaturated with Vitamin C in pulmonary tuberculosis cases. Fig. 1 gives a picture of

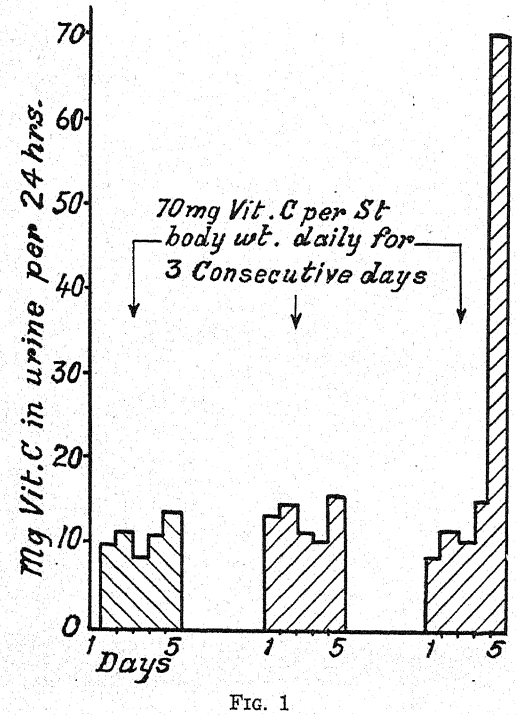


FIG. 1

this state of unsaturation. Administration of 70 mg. of Vitamin C per kg. of body weight for three consecutive days failed to saturate the body in most cases of pulmonary tuberculosis. In hæmoptysis, Vitamin C excretion falls rapidly and rises with the stoppage of hæmoptysis.

Administration of 350 mg. of Vitamin C daily to pulmonary tuberculosis patients, makes a decided improvement in the general blood picture, sedimentation rate, von Bonsdorff's count and Houghton's index.

The investigation is being continued.

M. N. RUDRA.

Department of Medical Chemistry,
Prince of Wales Medical College,
Patna,
March 18, 1939.

[1] *Lancet*, 1935, **1**, 71.
[2] *Ibid.*, 1935, **2**, 1399.

Supernumerary Chromosomes in Para-Sorghum

A CYTOLOGICAL examination of a number of plants of *Sorghum purpuero-sericeum* Ashers et Schwenf, grown at the Imperial Sugarcane Breeding Station, Coimbatore, from seeds received from Kew as originally collected from the Sudan, showed that the chromosome number in this species of Sorghum varies from $2n = 10$ to $2n = 14$. The haploid set of 5 which was also found in the two other para-Sorghums examined, *S. versicolor* Anderss and *S. dimidiatum* Stapf. could be easily identified in plants of *S. purpuero-sericeum* with 10 chromosomes, by their different lengths and the nature of their attachment constrictions (Fig. 1). A pair

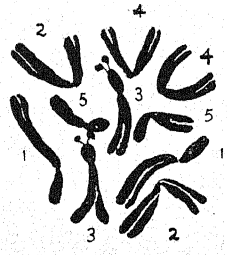


FIG. 1
Mitotic metaphase in *S. purpuero-sericeum*
$2n = 10$ × 2700

of nucleolar chromosomes possessing the characteristic satellite could be easily distinguished. The extra chromosomes in plants having more than 10 chromosomes are found to be identical with the smallest or fifth chromosome in length

and in having a sub-median attachment constriction (Fig. 2). At meiosis these extra

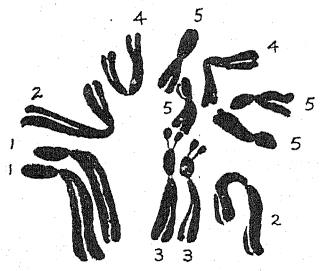


FIG. 2

Mitotic metaphase in *S. purpuero-sericeum*
$2n = 10 + 2$ × 2700

chromosomes may be seen as univalents or they may pair amongst themselves or with the fifth chromosome to form bivalents, trivalents or tetravalents.

The plants in which these extra chromosomes occur are found to be in no way different from those in which they are absent. It is highly probable that these supernumerary chromosomes like those first observed in Maize (Longley, 1927) and in Paspalum (Avdulov and Titova, 1933) are impoverished of genes. They, however, differ from the "B" chromosomes of maize in having a well-defined attachment constriction and in being homologous with one of the chromosomes of the normal haploid set.

Ten has been commonly reported as the basic number in the Andropogoneæ and the discovery of the five-chromosome species *S. versicolor* (Karper, 1930), has been considered as a direct evidence for this. However, multivalent associations are found in nearly all diploid species of Sorghum, and associations higher than quadrivalents reported in the tetraploid *S. halepense* by Huskins and Smith (1934). These workers have not found fewer than 7 units of association in the Sorghum material examined by them. This, and the frequency with which the chromosome number 7 and its multiples occur in Graminæ, raise the possibilities of this number rather than 5 being the basic number in Sorghum. The discovery of types amongst *S. purpuero-sericeum* with chromosomes ranging from $2n = 10$ to $2n = 14$ seems to indicate that this species of Sorghum probably represents one of the stages in the process whereby chromosomes are gradually eliminated in the evolutionary fall in the basic chromosome number from 7 to 5.

E. K. JANAKI AMMAL.

Imperial Sugarcane Station,
Coimbatore,
May 1, 1939.

Avdulov, N., and Titova, N., "Additional Chromosomes in *Paspalum stoloniferum* Bosco," *Bull. Appl. Bot.*, Leningrad, 1933, Ser. 2 (2), 165–72.

Huskins, C. L., and Smith, S. G., "A Cytological Study of the Genus Sorghum," *Jour. Gen.*, 1934, **28.**

Longley, A. E., "Supernumerary Chromosomes in *Zea Mays*," *Jour. Agri. Res.*, 1927, **35**, 769–84.

Karper, R. E., "Inheritance in Grain Sorghums," *Texas. Agri. Exp. Sta. Records*, 43rd Ann. Report, 1930.

How Mid-Rib Hardness affords Resistance to the Sugarcane Top-borer *Scirpophaga nivella* F., in India

THE sugarcane top-borer, *Scirpophaga nivella* F., is found almost all over India where at present about 4,500,000 acres are under sugarcane owing to the recent rapid development of the sugar industry.

In some of the sugarcane tracts about 70% of the sugarcanes at harvest time are found attacked by the top-borer. Attacked canes exhibit a drying shoot and become stunted and often have a bunchy top owing to the upper side buds developing into branches. Besides this damage, the attack by this pest kills off many young shoots and prevents the growth of many shoots into millable canes. At harvest time millable canes bored by this pest show an average loss of 20% in weight. During some years the loss is much more.

It has been found as a result of field observations carried out during 1937 and 1938 that some varieties of sugarcanes are definitely more resistant to this pest than others. All these resistant varieties have in common very strong hard mid-ribs in their leaves. The varieties that are badly attacked have rather weak mid-ribs often with drooping leaves.

Examination of the habits of the pest in the field during the last two years showed that the newly hatched larva gets into the shoot by first biting into a mid-rib a few inches above the base of an upper almost fully unfurled leaf and then tunnelling down the mid-rib to the base where the leaf is in contact with the shoot. From here it tunnels into the centre of the shoot. If a larva cannot get into the one particular leaf out of the whole bunch of leaves it perishes and what is more important is that if this particular leaf has a strong mid-rib, it is unable to pass into the mid-rib within a certain period from the time of hatching and it perishes for want of food and shelter. Usually when a plant has been attacked by one larva no other larva tries to get into the same plant.

Experimental cultivation on a replicated basis of different varieties of sugarcane during 1937 and 1938 has given statistically significant differences in favour of the strong mid-ribbed varieties regarding their resistance, during the whole period of their growth, to attack by *Scirpophaga nivella* F. General observations in sugarcane tracts also support the view that fewer *Scirpophaga nivella* F., are found attacking varieties of sugarcane with strong mid-ribs. Some varieties with weak mid-ribs have been found to be very badly attacked and reduced to bunchy, leafy, grassy clumps. In Bihar early in 1939 in a sugarcane field about to be harvested, it was found that the extent of *Scirpophaga nivella* F., attack in millable canes was 17% in the variety Co. 513 which has a strong mid-rib whereas the attack was 71% in the variety Co. 210 which has a weaker mid-rib.

The botanical factors that go with the strong mid-rib in the resistant sugarcanes are under study. Efforts are being made to popularise varieties of sugarcanes which combine in them the best economic factors together with that of the very strong mid-rib.

P. V. Isaac.

Imperial Agricultural Research Institute,
New Delhi,
April 21, 1939.

Origin of the Inferior Ovary in the Amaryllidaceæ

There are at present two main views about the origin of the epigynous flowers among the angiosperms. According to the first view, the inferior ovary is of receptacular origin and epigynous flowers are the result of a cup-like development of the floral receptacle which has fused with the original ovary wall and carried the other floral organs at its distal end. According to the second view, the epigynous flowers are the result of fusion of the ovary, and basal portions of stamens, petals and sepals. The wall of the ovary, therefore, consists morphologically, not of the receptacles, but of the basal portions of all parts of the flower.

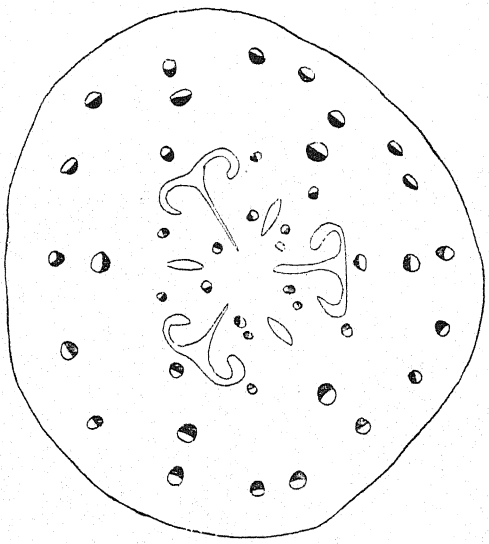


Fig. 1

Polyanthes tuberosa

Transverse section of the inferior ovary about its middle showing the arrangement of vascular bundles

In order to determine the exact morphology of the inferior ovary in the Amaryllidaceæ, we have carried out an anatomical investigation of the flower of *Polianthes tuberosa* Linn., and find that this supports the second view.

The traces for the various floral parts separate out from the stele of the receptacle below the ovary, and in the wall of the inferior ovary the bundles of the sepals, petals and stamens and

carpels are present quite distinct from one another. This is quite clear from the accompanying figure which represents a transverse section of the ovary about its middle. There are seen on the outside 18 bundles for the six perianth leaves, each perianth leaf being supplied by three (one midrib bundle and two lateral bundles). Next there are six stamen bundles, one for each stamen, just to the inside of the six midrib bundles of the perianth leaves. Finally we see in the middle of the transverse section, the vascular supply of the three carpels, consisting in each case of a dorsal bundle, two dorso-lateral bundles at the sides of the carpels, two ventral bundles and their lateral branches. It is thus quite clear that in this case the inferior ovary is the result of fusion of the basal portions of six perianth leaves, six stamens and ovaries of three carpels.

A. C. Joshi.
J. V. Pantulu.

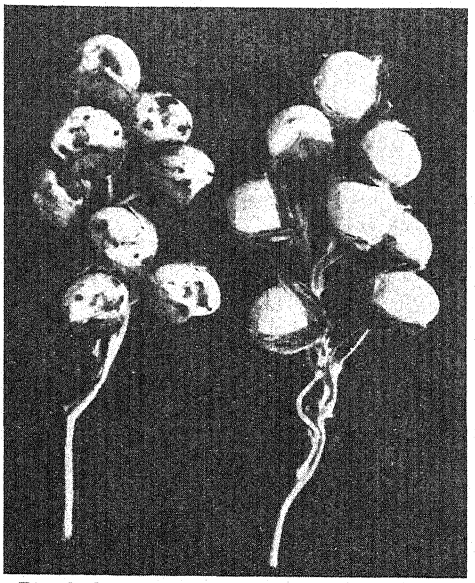
Department of Botany,
Benares Hindu University,
March 29, 1939.

The Occurrence and Inheritance of Purple Blotched Grains in Sorghum

The sorghum grain may be white or coloured, and may be pearly or chalky. When coloured, the colour may be yellow, red or brown. The depth of yellow and red may vary; so also that of brown, which could be independent or be superimposed on yellow or red. These variations will appear differently on pearly and chalky backgrounds. The many possible combinations of these factors result in the wealth of colours in the sorghum grain. The above colours are whole and are manifested over the whole of the pericarp. There are a few deviations from this whole colour manifestation. One such deviation in which the grain tips are purple coloured has been recorded[1]; here the purple tip is definitely round the stylar base.

In this note the occurrence and inheritance of purple blotched grains are recorded. Some of the varieties received from America, which are African in origin, are described as having flecked, red or black splashed grain. Possibly, these belong to the group of blotched grains.

The blotching is due to patches of purple coloured areas randomly distributed over the seed coat (see illustration). The colour of



Blotched Not Blotch d
Sorghum grains
Fig. 1

blotching may be reddish purple or blackish purple according as the root, leaf-sheath, and glume parts are coloured reddish purple or blackish purple. Blotching shows best against a white background. It could manifest on a background of other pericarp colours. Blotching is confined mostly to the pericarp layer. The colour is concentrated in the cuticle and epicarp, and gets lighter in the hypoderm and mesocarp, and in the cross and tube cells below. When blotching is heavy, it disintegrates all these layers and penetrates into the endosperm which it discolours slightly. In extreme cases there may be little pockets of air and this is revealed by tiny bubbles coming out when blotched grains are soaked. The blotches vary in size from a pin head to 2 mm. in diameter. Small blotches run into each other. They have no regularity in shape. They occur mostly in the exposed portions of the grains and could also occur at the base of the grain clipped up by the glumes and not exposed to light.

Blotching appears late in the development of the seed and is not noticed before the milky stage. Small blotches form in the dough stage of the grain and spread as the seeds mature.

Blotched grains are essentially African in origin. They are met with mostly among the Kafirs (*Sorghum caffrorum*, Beauv.), Feteritas (*S. caudatum*, Stapf.) and Nigricans [*S. nigricans* (Ruiz et Pavon) Snowden]. The Indian sorghums are free from blotching, though there are odd types of *Sorghum cernuum* evidencing a taint of blotching. Blotched grains tend to occur mostly in varieties with a blackish purple leaf-sheath and with grains having opaque and chalky colour.

In a cross between blotched and non-blotched grain types, the F_1 was blotched and the F_2 gave a simple monogenic ratio. In family A.S. 5379 which segregated for blotching there were 105 plants with blotched grains and 31 without blotching, showing that the blotched condition was a simple dominant to the common unblotched condition.

In crosses between a Kafir with blotched and purple tipped grain and a Milo with neither blotching nor purple tip, the F_1 had both blotching and purple tip. In the F_2 there was segregation for both the characters. Family A.S. 5382 gave a ratio of 64 purple tipped and blotched, 21 blotched alone, 20 purple tipped alone, and 7 with neither purple tip nor blotching. This segregation shows that the factor for purple blotching is independent of the factor P_{GT} which produces a purple tipped grain.

A factor designated PB produces purple blotches on the sorghum grain. PB is a simple dominant to pb. The factor pair PB — pb is independent in inheritance of the factor pair P_{GT} — p_{gt}, determining the presence or absence of a purple tip on the sorghum grain.

G. N. Rangaswami Ayyangar.
V. Panduranga Rao.
A. Kunhi Koran Nambiar.
Millets Breeding Station,
Coimbatore, S. India,
April 8, 1939.

[1] Rangaswami Ayyangar, *et al.*; *Proc. Ind. Acad. Sci.*, (B), 1938, **8**, 396–98.

Genic Differences Governing the Distribution of Stigmatic Feathers in Sorghum

The physical attributes of the style and stigma in sorghum, their length, and the length and distribution of stigmatic feathers have been given in a previous article.[1] The homology of style and stigma to the subule and column of the awn has been proved in a subsequent article.[2] Further data[3] on this homology were furnished, and the simple dominance of an equal stylar and stigmatic distribution to a longer style and a shorter stigmatic area has been recorded. In two subsequent articles[4,5] a localisation of the feathers and the extension of the feather to the stylar arms, with corresponding repurcussions on the awn was described and the inheritance of basal feathers given. In this note we are recording the fact that the distribution of the feathers on the stigma may be bushy or sparse with a genetic background.

The stigmatic feathers are very bushy in all cultivated varieties and also in the wild types. This is the normal condition. Among the African varieties of sorghum received through the courtesy of Kew, and grown at the Millets Breeding Station, three races of *Sorghum coriaceum* Snowden and one of *S. conspicuum* Snowden have sparse stigmatic hairs. To the naked eye this was easy to detect at the time of anthesis. The feathers in the sparse type were about 25 to 30 per one millimetre length of stigma as against 150 to 200 of the normal stigma. The individual feathers in the sparse type were slightly longer than those of the bushy type and the stylar arms were also a bit thicker.

A.S. 4378—a sparse feathered *Sorghum coriaceum* was crossed with A.S. 60—a bushy feathered *Sorghum durra*. The F_1 was like the bushy parent. In the F_2 the following segregations were obtained:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 4757	100	35
,, 4758	65	21
TOTAL ..	165	56
Calculated 3 : 1 ..	166	55

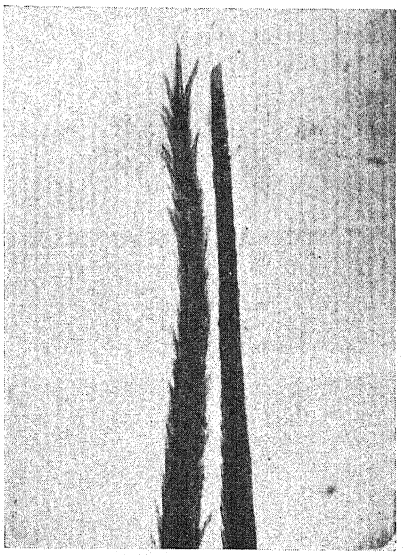
In the F_3, of the 13 bushy feathered selections taken from A.S. 4757, three turned pure and ten segregated as follows:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 5499	66	23
,, 5500	140	48
,, 5501	102	41
,, 5504	112	38
,, 5505	110	49
,, 5507	96	33
,, 5508	153	45
,, 5509	130	30
,, 5511	112	36
,, 5512	132	46
TOTAL ..	1153	389
Calculated 3 : 1 ..	1156·5	385·5

In the F_4 (from A.S. 5512) of 5 bushy selections, one was pure and four segregated as under:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 6362	63	24
,, 6363	71	26
,, 6364	69	19
,, 6365	76	23
TOTAL ..	279	92
Calculated 3 : 1 ..	278·2	92·8

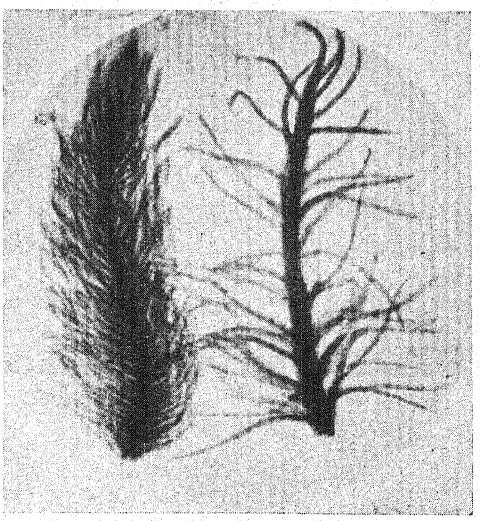
From the above data it will be seen that the normal bushy distribution of stigmatic feathers is a simple monogenic dominant to a sparse distribution, the sparse feathers being



Awn barbs

FIG. 1

about a sixth of the normal in number. In the *S. durra* parent, the stylar and stigmatic areas are about equal. In the *S. coriaceum* parent, the stylar length is greater than the stigmatic length. It was noticed that the denseness or



Bushy Sparse

Stigmatic feathers

FIG. 2

sparseness of feathers was independent of stigmatic length relatively to stylar length.[3]

Thus bushy feathered stigmas and sparse feathered stigmas have a monogenic difference, the former being dominant. Concurrently with the segregation for bushy and sparse distribution of stigmatic feathers, the respective homologous awns have close set and sparse barbs (*vide* illustration). A gene designated SB is responsible for the normal bushy stigma. Gene sb gives a sparse feathered stigma.

G. N. RANGASWAMI AYYANGAR.
A. KUNHI KORAN NAMBIAR.

Millets Breeding Station,
Coimbatore, S. India,
April 8, 1939.

[1] *Ind. Jour. Agric. Sci.*, 1936, **6**, (6) 1314.
[2] *Curr. Sci.*, 1935, **3**, 540–42.
[3] *Ibid.*, 1935, **4**, 176–77.
[4] *Ibid.*, 1936, **4**, 817–20.
[5] *Mad. Agric. Jour.*, 1938, **26**, 123–26.

On the Life-History of *Cylindrocapsa geminella* Wolle[1]

THE author followed the life-history of a *Cylindrocapsa*, which was found in Madras and which agreed in several respects with the description of *Cylindrocapsa geminella* Wolle.[2] The alga is filamentous and unbranched and its cells are ellipsoid to sub-rectangular in shape. Each cell has a large stellate chloroplast in the centre of which is imbedded a large pyrenoid (Fig. 1). A single nucleus is situated close to the pyrenoid. The chloroplasts of *Cylindrocapsa* have been variously described in text-books on Algæ as a massive chloroplast or as a massive parietal chlroplast or as a parietal, massive, often ill-defined chloroplast, but a careful examination of the living material shows very clearly that the chloroplast is definitely stellate. During cell division, the pyrenoid first divides into two and then the nucleus divides into two. The nuclear division is very interesting in being amitotic.

Sexual reproduction was observed during two successive years (1938 and 1939). The contents of some cells of the filament escape out as large, quadri-ciliate motile spores. One spore is formed from each cell. These spores, after swimming for a time, settle down on the filaments of *Cylindrocapsa* or of other algæ in the water and then each one of them immediately surrounds itself with a firm wall. Soon after this, further cell-wall layers are secreted by the protoplast. And the wall becomes lamellate and soon enlarges as a loose envelope round the protoplast which becomes rounded and lies loose in the centre (Fig. 2). This is the oogonium of the alga and the rounded protoplast inside is the single oosphere. The outer gelatinous envelope soon forms a beak-like opening on one side (Fig. 3). In this condition the egg is ready for fertilization.

From some smaller cells of the filament smaller swarm-spores are formed. These, except for their smaller size, are quite similar to the previous swarm spore. These also, after swarming, settle down on the filaments of *Cylindrocapsa* or of other algæ in the water and soon each one of them surrounds itself with a definite wall. The contents of this cell then divides into two or four protoplasts which soon escape out as small four-ciliated antherozoids. The antherozoid swims for a time and finally reaches an oogonium and enters through the aperture in the oogonial wall and fuses with the egg (Figs. 4 and 5). Soon after fusion, the egg surrounds itself with a wall.

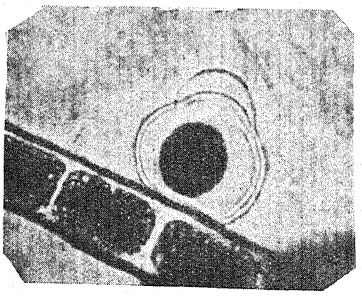
This type of sexual reproduction was observed repeatedly in the living material. The formation of an oogonium and an antheridium outside the plant by means of motile spores formed from the vegetative cells of the alga is something very unique and not known in any other green alga. The oogonium and the

[1] This paper was read before the Annual Meeting of the Indian Academy of Sciences at Madras, on 20th December 1938.

[2] The alga in its life-history differs in several respects from *C. involuta* and also from *C. geminella*. These points will be described in the fuller paper. The author, however, has tentatively referred the alga to *Cylindrocapsa geminella* Wolle in this note.

antheridium formed by the motile spores must be considered as single-celled female and male plants, respectively. In the case of the male plant there is a certain amount of resemblance to the dwarf males of *Oedogonium*, but there has been no instance of any dwarf female plants so far similar to the one seen here. A certain amount of resemblance is, however, seen in the behaviour of the large ciliated oosphere of *Aphanochæte*. In the case of *Aphanochæte* an oosphere is formed inside the oogonium. This escapes from the oogonium as a large, quadri-ciliated gamete which soon comes to rest somewhere outside the plant. It is then fertilised by a quadri-ciliated antherozoid. The interesting feature here is that the egg is fertilized outside the oogonium. But, in the case of the Madras *Cylindrocapsa*, the motile spore which escapes from the ordinary plant is not the oosphere of the alga, but is merely a spore which forms the single-celled female plant which ultimately becomes the oogonium. So the resemblance between *Aphanochæte* and the present alga does not extend beyond the fact that the egg is fertilized outside the main plant in both the algæ, but the structures that are concerned in the process are not the same in the two algæ. The significance of this will be further discussed in detail in the full paper.

1



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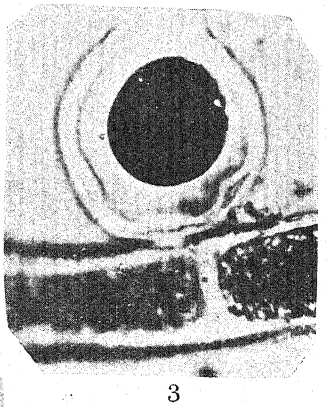

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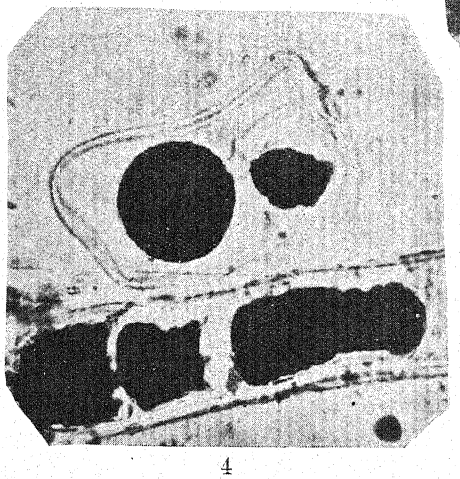

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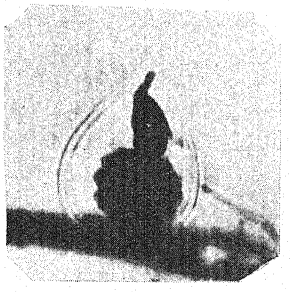

5

Cylindrocapsa geminella Wolle

Fig. 1.—Cells of the filament showing the stellate chloroplast and the pyrenoid. × 337.

Fig. 2.—Oogonium formed by a motile spore outside the plant. × 205·3.

Fig. 3.—Oogonium before fertilization with the oogonia wall opened at the top. × 1001·5.

Fig. 4.—Oogonium with an antherozoid close to the egg (four cilia seen on the antherozoid). × 819·5.

Fig. 5.—The antherozoid fusing with the egg. × 1001·5.

M. O. P. Iyengar.
University Botany Laboratory,
Madras,
May 1, 1939.

A Metal Image of Manjusri

MANJUSRI had enjoyed a chief place in the Buddhist Polytheism. The cult of Manjusri seems to have originated in India but, when it was introduced into China, had taken a different form; and it was from China that the cult had spread to Nepal. In Mahayanism, Manjusri is regarded as a Bodhisattva.[1]

It is difficult to determine the date of the introduction of this deity into the Buddhist pantheon. However, the Chinese pilgrims, namely, Fa-hien, Hiuen Tsang, and I-tsing, speak of the worship of Manjusri in India.

The *Sadhanamala*,[2] a work in Sanskrit, contains *Dhyanas* describing several forms of Manjusri; and the most common representation of this form in sculpture carries the Sword and the Book in its right and left hands.

FIG. 1

A metal image of Manjusri, measuring 2½" in height, comes from Kanchi (Conjeevaram) having been discovered there (I am informed) in a gutter. The pedestal on which this image must have been installed is now lost and the image itself is faintly corroded at the back. Though small, the figure looks beautiful and was probably (judging by its size) under private worship and discarded later by someone.

That Kanchi had been a great centre of Buddhist faith and that many schools of Buddhist philosophy flourished therein are only too well known. A large number of stone images of the Lord have been noticed here but a figure of Manjusri representing a particular type of Mahayanism has not been so far traced. This metal image, therefore, appears to be a valuable archæological find.

One form of Manjusri has the nomenclature of Vak or Vajraraga which is described by Bhattacharya[3] as follows:—

"Vajraraga or Amitabha Manjusri is one-faced and two-armed. His hands are joined in the lap, forming the *Dhyana* or *Samadhi Mudra*. In this respect he is identical with his sire whom he bears on his tongue. But he may be distinguished by the ornaments he wears and by the image of his Sire if represented on the crown. ..... Images of this form of Manjusri are extremely rare in India with the exception of the one at the temple of Bauddhanath in Nepal."

The special features which characterise this image are (1) *Mudra-Samadhi*, (2) *Asana-Vajraparyanka*, (3) Ornaments and Dress.

The image from Kanchi seems to agree well with the description given above of Vak or Vajraraga Manjusri with the exception of an object which the figure holds in its hands. Even in the case of the Manjusri whose figure is reproduced by Bhattacharya, a more or less similar kind of object is visible though unexplained by the author. As regards the Conjeevaram image, the object appears to be a human head which, perhaps, represents the head of Amitabha or the Sire on whom the Manjusri is supposed to concentrate.

Since the provenance of this image is Kanchi we may suppose that Manjusri cult was prevalent in this historic city in the early centuries of the Christian era. The very fact that Kanchi attracted the attention of Vajrabodhi, a Great Worshipper of Manjusri, proves the existence of Tantric form of Buddhism in Kanchi in the seventh century A.D. In this connection it is well to remember the statement of the late Gopinatha Rao who says that the famous Kamakshi temple was originally dedicated to the Tantric Goddess Tara.[4]

C. MINAKSHI.

Madras,
May 2, 1939.

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[1] Hastings' *Ency. of Religion and Ethics.*
[2] *Gaekwad Oriental Series, Sadhanamala.*
[3] *Buddhist Iconography*, (2), p. 18.
[4] *Ind. Ant.*, **44**.

Grafting of Apples on *Eriobotrya japonica* Stocks

MR. M. J. THIRUMALACHAR has reported in the March Number of *Current Science* a case of grafting of Apple on *Eriobotrya japonica*. He has figured a successful graft six weeks old.

We wish to mention that successful experiments in grafting of apple on *Eriobotrya* were conducted in the Fruit Nursery attached to Lalbagh in the year 1936. About half a dozen successful plants of 1936 are growing in the Nursery, one of which has put forth a bunch of flowers (Fig. 1). From the observation so

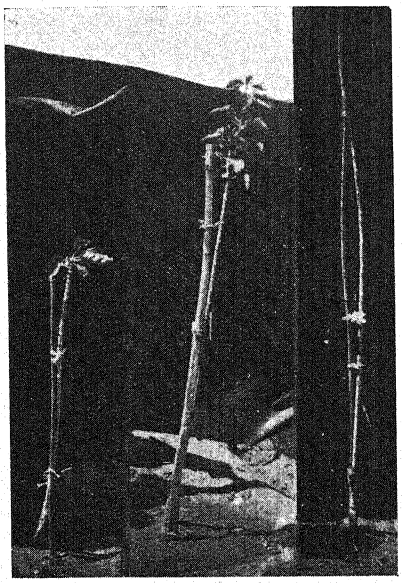

FIG. 1

far recorded the leaves of the budded apple on *Eriobotrya* is much coarser and the rate of growth slower than that of apple on apple. Further work on the morphological aspects is being pursued. At the Fruit Research Station, Hessarghatta, budding apple varieties on *Eriobotrya* is being conducted on a large scale (Fig. 2). There have been a number of successful takes, as against Mr. Thirumalachar's failure to make the budded plants make much headway.

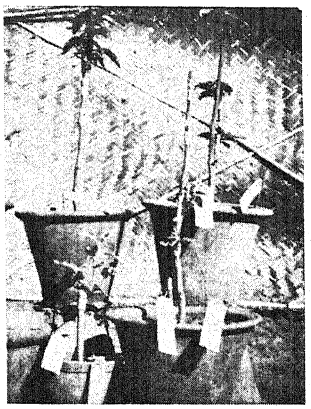

FIG. 2

Another contention of Mr. Thirumalachar is that the problem of a suitable apple root-stock in India is to find one which is resistant to the root disease. Our experience is that in addition to the root disease—collar-rot—our real problem is the longevity of the apple and the object in trying apple buds on *Eriobotrya* is to lengthen the life of the apple plant, as *Eriobotrya* is known to live much longer under the conditions obtained in Bangalore.

In Algeria, Pears are said to be regularly budded on *Eriobotrya*. Thus it is not the first time that *Eriobotrya* has been looked upon as a likely stock in pomological work in the warmer countries.

It is in the programme of the Fruit Research Station, Hessarghatta, and the Lalbagh Nursery, to try various Rosaceous stocks for the different varieties of apple. Anatomical work on the nature of the union between the stock and scion is a regular item of work at the Research Station.

L. S. DORASAMI.
Horticultural Department in Mysore,
Bangalore,
April 12, 1939.

REVIEWS

Background to Modern Science. (Ten lectures at Cambridge arranged by the History of Science Committee, 1936). Edited by Joseph Needham and Walter Pagel. (Cambridge University Press), 1938. Pp. xii + 243. Price 7/6 net.

We have read this book with absorbing interest. We conclude that no praise can be too great for the Editors. Their plan of providing a historical and cultural background to the formal instruction of science will be widely appreciated. It is this aspect of science that clothes it with flesh and blood. Every student of science ought to be fully acquainted with its evolutionary history, the successive stages in the accumulation of knowledge of the facts and phenomena of Nature, leading ultimately to the establishment of at least partial mastery over the forces and factors of the physical environment for the promotion of human civilization and culture. No knowledge can be more significant than an understanding of our origins and development and no study can be more valuable which has led us to a deeper appreciation of the properties and forces hidden in the objective world. An account of the attitude of modern scientific knowledge to the growth of social institutions, to the satisfaction of human needs and aspirations should have a great interest for those engaged in building up a "scientifically planned society".

The Editors have succeeded in their task of presenting the readers with a picture of "the working of the 'cutting edge' of human scientific activity and how it has been at work during the last half century in many different fields", and this picture is an indispensable background for special knowledge. The lectures were composed by F. M. Cornford, Sir William Dampier, Lord Rutherford, W. L. Bragg, F. W. Aston, Sir Arthur Eddington, J. A. Ryle, G. H. F. Nuttall, R. C. Punnett and J. B. S. Haldane.

The book does not preach science. The contributors expound some of the new knowledge and wisdom which man now possesses and it is obvious that the power to make or mar his destiny is also in his hands. The subjects dealt with in the book are "Greek Natural Philosophy and Modern Science; from Aristotle to Galileo; Forty years of Physics; Forty years of Crystal Physics; Forty years of Aromic Theory; Forty years of Astronomy; Forty years of Physiology and Pathology; Forty years of Parasitology and Tropical Medicine; Forty years of Evolution Theory; Forty years of Genetics". This imposing array of subjects dealt with by the most eminent leaders of science must invest the book with an importance, rarely falling to the lot of publications of similar or bigger size.

The Theory and Practice of General Scince. By H. S. Shelton. (Thomas Murby & Co., London), 1939. Pp. vii + 123. Price 3*sh.* 6*d.* net.

The conventional specialised science courses in our High Schools are gradually replaced by a more generalised scientific instruction which will certainly enable the pupils to gain a more rational and comprehensive view of the objective realities of the world around them. This interesting book proposes to give clear and illuminating answers to the questions formulated by the author. "What is this general science? What should be its content? Is it a collection of snippets or a connected course? How should it be taught? What time is required to teach it efficiently? How should the teacher prepare himself for the task? These questions form a wide range of enquiry and they are treated in the book very comprehensively and satisfactorily. Science masters of High Schools will welcome this book, and no doubt will read its interesting and stimulating chapters with avidity. Perhaps those in charge of directing public education and others interested in the advance of education will greatly profit by a perusal of this book and a deeper knowledge of the place of general science in the curricula of secondary education, will lead to a clearer definition of the policy of education and to the provision of adequate finance. Governments are slow to recognise—even if they recognise are slow to act—that science is a great force in the continuous transformation of society in material production and in culture.

Educating for Democracy. Planned and Edited by J. I. Cohen and R. M. W. Travers. (Macmillan & Co., Ltd.), 1939. Pp. xxx + 458. Price 10/6 net.

As a comparison volume to the Editors' previous publication *Human Affairs,* the present work will be welcomed by those who pursue education as a profession as well as by the intelligent public who will find in the twenty-three contributions comprising the book subjects sufficiently wide and varied to instruct and stimulate them. The two editors who are ardent psychologists have succeeded in persuading about a score of leading educational exponents to write a series of brilliant articles on the fundamental problems of the conscious organisation of the educational principles and practice for liberalising human life, founded on social justice and freedom. Education being conceived as a social science, the articles constitute a unitary whole, whose aim is to present the new knowledge and wisdom, necessary to capture and exploit the machinery of mind, as a means for controlling human destiny. The purpose of the book is to emphasise the view-point that education shoud be the hand-maid of democracy, which is understood to be synonymous with scientifically planned human society, in which the needs and aspirations of its members must be the first charge on those governing its affairs. According to the editors, the book "gives a design for living in a free society, alive to the affairs of every-day life".

Whatever may be the official definition of education or the popular conception of its aims, its main purpose is to supplant the natural instincts by the inculcation of the standards of conduct approved by Society. For the attainment of this desirable ideal, Text-books are prescribed, and teachers are employed to expound to the bewildered young men their mysteries of knowledge and wisdom. At the end of this process, examinations are held for the purpose of testing the degree of mental and moral cultivation attained by the young scholars, and upon the evidence given, they are declared as good citizens or as misfits. We forget, however, that the former group have only succeeded in inhibiting their natural anti-social impulses to a greater degree than the latter, and the deposit of knowledge over the aggressive instincts, whether thin or thick, will easily crumble when tests of fear, hate and irrationality are applied during grave national crises. Education is essentially a barter, the exchange of stone-age mentality for mid-Victorian culture and code of morals, and in the nature of things the transaction can never be complete for the sacrifice involved amounts to the surrender or displacement of the whole world of animal inheritance inseparable from the evolutionary history of man. Leaders of education are confronted with the question whether under the influence of education, man has got rid of all traces of primitive anti-social instincts. and it would not do for them to answer that knowledge has enabled them to add to the material comforts and conveniences of society, has diminished the incidence of diseases, and secured greater insurance of public health and longevity and has rendered possible the orderly progress of mankind.

These general reflections are bound to arise from a perusal of any book on Education and they have no particular reference to the work of Cohen and Travers. We agree that the book gives a design for living in a free society and is alive to the affairs of every-day life. Each article is thoughtful, complete and provocative. The reader will find in the book sufficient matter worth reading and pondering over.

Ergebnisse der Enzym forschung. Edited by F. F. Nord and R. Wiedenhagen. (Akademische Verlagsgesellschaft, M.B.H., Leipzig), 1938, Vol. 7, Pp. 437.

This is the seventh volume of the well-known series with which all biochemists are familiar. The high standard which it has maintained has been made possible through the untiring efforts of the enterprising editors who have been able to secure international co-operation in reviewing the most outstanding achievements in the domain of enzyme chemistry.

Sixteen contributors distributed among seven different countries, England, France, Germany, Czechoslovakia, Finland, Sweden and U.S.A., who are responsible for the articles in this volume, secure for this enterprise a status which is manifestly international. Most of the subjects discussed in the volume are either those in the forefront of enzyme chemistry or those which have reached a well-defined landmark. A discussion of the investigations of dehydrogenases by Thunberg, the founder of the methylene blue technique, is both opportune and appropriate. The editors could not have

chosen a better contributor than Warburg to speak on the chemical contistution of enzymes, a field in which he has made fundamental and spectacular contributions. The two articles on sulphatases and nucleases, serve to clarify the position with regard to systems which have received little attention. Helferich's contribution on Emulsin, is an authoritative treatise, covering the researches carried out by himself and his pupils. From Princeton comes a contribution on the preparation of one more crystalline enzyme, carboxypeptidase. Special attention should be invited to the stimulating article of Marrack on Immuno-chemistry and its relation to enzymes.

It is superfluous to commend such a volume as this, which is internationally recognised, widely appreciated and eagerly welcomed by biochemists all the world over.

M. S.

A Manual of Pteridology. Edited by FR. VERDOORN, in collaboration with A. H. G. Alston, I. Andersson-Kottö, L. R. Atkinson, H. Burgeff, H. G. du Buy, C. Christensen, W. Döpp, W. M. Docters van Leeuwen, H. Gams, M. J. F. Gregor, M. Hirmer, R. E. Holttum, R. Kräusel, E. L. Nuernbergk, J. C. Schoute, J. Walton, K. Wetzel, S. Williams, H. Winkler and W. Zimmermann. Foreword by F. O. Bower. (The Hague: Martinus Nijhoff), 1938. With 121 illustrations. Price 24 guilders.

Dr. Verdoorn is well known for his success in inducing botanists in many countries to engage in co-ordinated activities. Here is one more proof of his commendable efforts in this direction. The two sister volumes, the *Manual of Bryology* published in 1932 and the *Manual of Pteridology* now before us, are intended "to provide those working on the Archegoniatæ with a new breadth of view and help them to put their problems and results in a truer perspective". The editor has "urged his contributors to give more space to new ideas than to an academic summary of established knowledge". It would be difficult to claim that this wish has been realised: the work is in the main a summary of recorded facts but as such it is authoritative and up to date. English, French and German are to-day the universally recognised languages of science. The fact strikes one that in this international handbook there is not a single article in French.

The opening chapter, by Professor J. C. Schoute, deals with the general morphology, and this is followed by another chapter by the same author on the anatomy, of the Pteridophyta. Apart from much descriptive matter which by itself is not easy reading, a useful discussion is given of the disputed morphological nature of several organs. Professor Schoute has no room for indecision in these matters that vex other botanists. He has no doubt as to the foliar nature of the sporangium-bearing complex in the Psilotaceæ, and he is equally certain that the rhizophores of *Selaginella*, in spite of their root-like steles, are modified stems. The stigmarian axis is undoubtedly a rhizome, and its "rootlets" probably modified leaves. The dichotomously lobed stem base of *Pleuromeia* is regarded as homologous to the stigmarian axis, so that its attached rootlets would also be modified leaves. But the lobed stock base in *Isœtes* does not seem to offer any analogy with the Lepidophytes; and its roots are clearly true roots. Nor does the condensed base of the stem in *Nathorstiana* appear to have anything to do with the stem base in the Lepidophytes.

S. Williams of Glasgow follows with a chapter on experimental morphology. Perhaps the outstanding feature of this contribution, apart from its clarity of style, is the wholesome reluctance of the author in drawing conclusions from the results recorded. The most hopeful lines of attack are experimental investigations of the physico-chemical aspects of morphology, particularly with the help of hormones; experimental cytogenetics; and, where possible, a correlation of the results thus obtained with the observed facts of palæobotany. In the solution of phylogenetic problems "experiment seems likely to be of very limited service".

The fungous associates of the Pteridophyta receive treatment in two chapters; of these the first, by Mary J. F. Gregor of Edinburgh, gives little beyond a record of occurrences. The significant chapter is that on mycorrhiza by Professor Hans Burgeff of Würzburg. This is an exceptionally well illustrated account of the intimate relations between fungi and the underground organs of vascular cryptogams.

After a brief chapter on galls by W. M. Docters van Leeuwen there follow three chapters, by L. R. Atkinson, W. Döpp and I. Andersson-Kottö dealing with the cytology

and genetics of Pteridophyta. The first two of these contain a mass of descriptive data on the structure of the nucleus, both in the somatic and reproductive cells, in the normal life-cycle as well as in its variations. Numerous illustrations are reproduced from original sources. *Inter alia* the cytological aspect of apogamy and apospory is discussed; also polyploidy and aneuploidy. The chapter on genetics by Andersson-Kottö shows that the modern ferns present rich material for genetical observations. An advantage over the angiosperms is that the gametophytic generation is well developed; it can be kept almost indefinitely by subdivision and employed for repeated experiments with self and with cross fertilisation.

Du Buy and Nuernbergk, in a chapter devoted to growth and movements, discuss, among a variety of subjects, the influence of hormones on the development of prothallia; the importance of environmental conditions, especially of light, on the gametophyte; the phototropism and geotropism of rhizoids and leaves; regeneration and wound reactions; hygroscopic movements in the ferns and horsetails; and the tactic movements of spermatozoids.

From the biochemical and metabolic point of view scarcely another group of plants has been so little investigated as the Pteridophyta. A useful chapter by Wetzel brings together in 34 pages a quantity of data concerning the constitution of the cell membrane and cell contents, as well as experimental data on the various physiological processes, particularly assimilation and respiration.

The ecology and geographical distribution of modern members of the group occupy three chapters, covering about 90 pages. H. Gams deals with the ecology of extratropical pteridophytes and Holttum with that of the tropical forms, while Hubert Winkler treats of the purely geographical aspect. There is an inevitable overlap in the scope of the three authors, but they bring together much scattered material of interest and give a number of interesting photographs of tropical ferns.

Hirmer gives a condensed account of the distribution in time and space of the various genera of fossil Pteridophytes. As usual he is up to date and accurate but has overlooked that *Azolla* occurred in the Tertiaries of India and England and in the Pleistocene of Holland and Russia. Kräusel gives a brief article on the Psilophytales, largely based on his own work. It is useful to see in the brief compass of these two authoritative chapters by Hirmer and Kräusel a large number of genera (many of them recently created and known to most botanists only by name) placed in definite groups, even though further knowledge may make regrouping desirable. One would have welcomed a few sketches showing the general appearance of the more important of these genera.

Walton and Alston give a compact scheme of classification for living and extinct lycopods and this is followed by two further chapters by Hirmer on the Psilotaceæ and on the Articulatæ. The modern ferns are classified by Christensen and the fossil ferns again receive a brief treatment from Hirmer. The *Pteridophyta incertæ sedis* include that intriguing group, the Cladoxylales, which until recently most authors preferred to regard as gymnosperms.

The concluding chapter (60 pages) is by Professor W. Zimmermann of Tübingen who has bestowed much careful thought to the difficult questions of phylogeny. After giving a rapid review of the literature he surveys the sporophytic generation of the early Pteridophytes, first in the morphology and anatomy of its vegetative organs and then in its reproductive organs. Numerous diagrams illustrate the author's views, some of which we know from his important published works. There is much originality exercised in tracing the course of evolution in leaf form, in the relation between leaf and stem which in turn must largely influence the evolution of their steles, and lastly in the relation between leaf and sporangium. These problems are so puzzling to students of morphology that no fundamental agreement can be foreseen in the near future. Professor Zimmermann, at any rate, is one of the few recent botanists who have made a comprehensive essay into the possible ways in which the tangled mass of facts can be fitted into theory. New discoveries in palæobotany irresistibly tickle the imagination but they equally often put a damper on pet theories. Should we, therefore, stop theorising or should we, like Professor Zimmermann, go courageously forward? On the whole, if the aim is to stimulate thought, we would prefer the latter alternative, provided one knows where to apply

the curb. For this reason Professor Zimmermann deserves the thanks of his colleagues, even though they may not agree with all his views.

Reviewing the *Manual* as a whole, several commendable features emerge. Its greatest merit is that it brings into one volume a variety of authoritative articles on many different aspects of the group. There is some evidence of a lack of co-ordination; for example, some avoidable overlapping, and the lack of a single consolidated but classified Bibliography for handy reference. The printing is excellent, misprints are rare, and the quality of illustrations is, on the whole, very good although the quantity varies considerably in the different chapters.

Considering everything the *Manual of Pteridology* is a welcome addition to the literature and botanists have good reason to be grateful to Professor Verdoorn.

B. SAHNI.

A Text-Book of Applied Hydraulics. By Herbert Addison. Second Edition, revised and enlarged. (Chapman & Hall, Ltd., London), 1938. Pp. 435. Price 21/-.

It is a valuable treatise on Hydraulics. The book is useful for beginners as well as for students of advanced Hydraulic Engineering. It is divided into two parts. The first part deals with the fundamentals of Hydraulics, *i.e.*, static and dynamic pressures of liquids, flow of water over notches, weirs, through pipes and in channels.

The different principles have been dealt with in a very clear and intelligible manner. Only selected and important formulæ are given. This is a very good point in the book. Usually books on Hydraulics contain so many mathematical formulæ that the beginner is left in confusion. The characteristics of viscous, turbulent and shooting flow are explained in detail in a very clear manner.

Regarding Part II of the book, *i.e.*, practical application, the most important chapters are on the hydraulic turbines, their construction and working and the pumping machinery. These pages contain a lot of information useful to Electrical Engineers.

The discussion of flow over weirs under free fall and under highly submerged conditions and also of the actual operating conditions of weirs, barrages and regulators is very interesting and highly useful to Irrigation Engineers.

The last chapter deals with the instruments such as pittot tubes, current meters, venturi meter and Helix meter for the measurement of velocity, rate of discharge and direction of flow.

The book on the whole is a useful contribution to Hydraulics.

One or two points are, however, suggested. In view of the recent advances made on the problem of subsoil flow, it is necessary to devote at least one chapter to the flow of subsoil water and its application to the design of dams, weirs and barrages on sand foundation. Secondly, the value of the book will be very much enhanced if frequent references are made to model results with a view to elucidate certain points. The author has made occasional references but this is not enough considering the tremendous amount of important research work carried out on hydraulic models.

H. L. UPPAL.

Plant Physiology. By Edwin C. Miller. Second Edition. (McGraw-Hill Publishing Co., London), 1938. Pp. 1201. Price 45/-.

Seven years can be considered a short period for the second print of a volume like Prof. Miller's *Plant Physiology*. It therefore bears testimony to the usefulness of the book which must have proved a valuable guide both to students and research workers alike.

A few years ago the need for a suitable text-book on plant physiology, embodying the rapidly advancing knowledge on the subject, was keenly felt both by teachers and students, and Professor Miller was the first to satisfy the need by bringing out the first edition of the book in 1931. The book published by the author went beyond the range of a text-book and it was welcomed by research workers in the field of plant physiology. It served a twofold objective; a text-book as well as a reference book on account of the up-to-date references to literature.

As a text-book, it has many good points. It contains valuable summaries of the existing knowledge on all fundamental life processes of the plant, like respiration, protein synthesis and the intake of salts. Current views and theories of the mechanism of some processes are described in a lucid

style with arguments and experimental evidences for and against each concept. The theories of the ascent of sap are ably discussed and an impartial account of the experimental evidence on the conflicting views regarding the path of conduction of elaborated food substances in the plant's body is given.

As the book is perused, one cannot help feeling that at many places no effort is made to link up the findings of different workers on a particular topic in a coherent manner. It seems as if the original papers are mentioned merely for the sake of mentioning. But this defect cannot lower the value of the publication as a text-book as such portions are probably not intended for students taking degree courses in Botany. They may be intended for the benefit of the teachers and research workers who can, if required, look up the original papers. The author has also made it clear in the Preface to the second edition that he has tried to present data impartially without putting his own ideas and that is a commendable attitude to adopt when one has to deal with a very large number of topics.

Professor Miller's book is as much agronomical in its contents as it is physiological wherein pure and applied physiology are treated side by side. This is an important feature of the book and, therefore, it should be of great value to those engaged in agronomical work. A knowledge of plant physiology is essential for those who tackle agricultural problems in order to understand and interpret rightly the plant's behaviour under different conditions of field experimentation. Professor Miller is himself engaged in agronomical research and has thus realized the necessity and importance of physiological knowledge in agricultural science. He has, therefore, kept this viewpoint before him while writing this book.

The first edition of the book covered 900 pages, while the second edition is greatly enlarged and covers 1,200 pages, of which 300 pages are devoted to Bibliography and Index. Many new topics like the physical and chemical properties of the cell wall, theories of cell structure, vitamins, growth hormones and vernalization, are newly added. The chapters on "the elements absorbed by the plant" and on "the processes of growth of plant" are enlarged and more literature is incorporated in them. Thus the second edition of the book marks a great advance on its first edition and has made up the deficiencies in the latter.

The book is well written and the huge mass of data is well sifted, segregated and arranged. To be brief, it is a good book for the Physiologist and the Agronomist and every institution and Experimental Station should possess it for the benefit of its teachers and researchers.

R. H. DASTUR.

Plant Physiology. By Nicolai A. Maximov. Edited by R. B. Harvey and A. E. Murneek. Second English Edition: Translated from the Russian by Dr. Irene V. Krassovsky. (McGraw-Hill Publishing Co., London), 1938. Pp. x + 473. Price 24*sh.*

The second edition of this well-known handbook of plant physiology is welcome as a text-book as well as a teacher's handbook. Advanced students are already familiar with the writings of "The Plant in Relation to Water". This handbook brings the author within reach of the undergraduate. The subject is arranged in such a manner as "to acquaint students with the general physico-chemical foundations of the plant, with its chemical composition, and with its mechanisms of digestion and metabolism. After these introductory chapters, we pass to a discussion of some of the more important vital functions such as respiration and growth, which are most clearly manifested already from the first growth stages—the germination of the seeds."

Up-to-date knowledge has been introduced in a most readable manner. Each chapter is almost autonomous and yet all of them have been threaded together into a complete whole. The physiological principles of well-known agronomic and horticultural practices have been elucidated in different chapters of the book. This will make the book of wider appeal than only to the student of 'pure' plant physiology.

In short this is a handbook which will be of use to the student and teacher alike.

P. P.

District Development Scheme. By Sir M. Visvesvaraya, K.C.I.E., LL.D. (The Bangalore Press), 1939. Pp. vi + 63.

The appearance of this provocative brochure with constructive proposals for district development is opportune. Young men fresh from colleges are exhorted to go to

rural areas. Provincial ministers exhibit a tender solicitude for the improvement of villages. The students are bewildered. The ministers make speeches. Under the circumstances the book must be deemed to perform a distinct public service.

Sir M. Visvesvaraya is a distinguished administrator, whose knowledge of rural affairs is as intimate as his experience is rich and varied. He has put forward concrete schemes, fortified in every detail by definitely practical suggestions, which even a raw graduate can work, provided he is inspired sufficiently by a missionary zeal and true patriotic fervour.

We have perused this little book with diligence and care. We have concluded that the safety and progress of the masses cannot be entrusted to the hands of a few clever officers, without the intelligent and cordial co-operation and sympathetic understanding of their policies and projects on the part of the people. The book expounds the thesis that the co-operation of the village people is an instrument of immense power, which, wisely directed, would enlarge their personal lives, by stimulating increased output and by raising the standard of their economic efficiency. The author in his inimitable way emphasises the fact that if the citizens of to-morrow are to choose wisely, the village and the district must become keenly alive to the technical forces and the new powers which will shape and determine their ultimate destiny. In the three important chapters, "Aids to Development", "Policies and Implications" and "A Concrete Programme", the author has developed his schemes of planned organization, whose aim is to enable the village people to strive forward to self-consciousness, and to discover to them the resources for the enrichment of rural life and its activities. So the mind and will of every officer in charge of district administration and of every public-spirited citizen should be focussed on the fundamental fact that technical opportunities, close co-operation and planned organization and definite schemes of development should be their concern, if the country as a whole should progress and take its place among the more advanced nations. According to Sir M. Visvesvaraya knowledge and experience should be habitually considered in terms of human advancement, and both should be presented to the people as a bag of tools for promoting the material and cultural basis of the good life. We hope that the book will be accorded a warm reception, and we confidently recommend this authoritative contribution to "Planned Development" to the study of all good citizens and provincial administrators.

Über ein neues mechanisches Gewebe (Helicenchym) in den Blättern der *Cornus*-Arten. By Riukiti Kano. With 1 Plate and 2 Text-figures. (*The Botanical Magazine*, Vol. LI, No. 612), 1937.

In this brief but well-illustrated paper the author describes a new type of mechanical tissue to which the name *helicenchyma* is given. It is found in the leaves of *Cornus* species (*C. kousa, C. florida*). The tissue consists of spirally thickened but *not lignified* prosenchymatous elements with the thickening bands much broader than in spiral vessels. The bands are attached to the cell wall by a narrow base. The tissue occurs in strands running longitudinally near the leaf-margin and extending basipetally into the petiole in two marginal strands. It would be interesting to investigate other species of *Cornus* and other genera of *Cornaceæ* to see if this tissue occurs there also.

B. SAHNI.

Sampling and Analysis of Carbon and Alloy Steels. Methods of the Chemists of the Subsidiary Companies of the United States Steel Corporation as revised to 1937. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1938. Pp. 356. Price $4·50.

During recent years the great variety of steel products made under exacting specifications demand rapid, concise and accurate methods of analysis both during their manufacture and use and the present volume is particularly welcome to the analytical chemist in this direction.

This book replaces two former booklets dealing with the sampling and analysis of plain carbon steels and of alloy steels. The methods for analysis are grouped by elements and are limited to those which are considered the most practicable and satisfactory. The book starts with a detailed account of the methods of sampling for ladle, semi-finished and furnished products and after outlining the quick identification tests and treating chemical separations in two separate chapters, goes on to consider the

various elements individually. A critical discussion is given in the Appendix on the methods of determination of sulphur or carbon and sulphur by combustion in oxygen and three methods developed by the chemists of the Corporation are given in detail. In another Appendix brief outlines are given for estimation of oxygen or oxygen, hydrogen and nitrogen by the vacuum fusion and hydrogen reduction methods and for oxides and other non-metallics by the iodine, chlorine, electrolytic solution and the acid solution methods.

Practically all the elements entering into steel have been covered. Of particular interest is the outline for estimation of total aluminium, metallic aluminium and aluminium oxide in steel. There is no reference to methods for the determination of lead which is now being used in free-machining steels. This appears to be an omission considering that even rarely occurring elements, boron, beryllium and cerium are not overlooked.

The use of perchloric acid is strongly advocated throughout the book. Despite the numerous advantages of this reagent its use is attended not without a certain hazard and the necessary precautions required to avoid explosions have more or less stood in the way of its general application.

Some of the well-known European standard methods of works analysis such as the gaseous volumetric combustion method for carbon determination by the Strohlein or similar apparatus, the volhard-woulf method of determination of manganese in high manganese steels, basic acetate separation of iron, etc., do not appear to have been adopted by the Chemists of the Corporation. Some of the methods described in the book appear to be somewhat long by modern works standards, but where highest precision is necessary the recommendations are no doubt justified.

The book is well printed and presented and contains very few printers' errors—those that have come to the notice of the reviewer are page 87, line 39 "iron"; page 308, line 10 "ammonium"; and page 309, line 22 "NaOH". There is no Alphabetical Index, but the Table of Contents is extensive. The book should find a useful place in the shelves of iron and steel chemists.

N. SEN.

The Living Body, A Text-Book in Human Physiology. By Charles Herbert Best and Norman Burke Taylor. (Chapman & Hall, Ltd., London), 1939. Pp. xxii + 563. Price 18*sh.* net.

According to the authors the book is primarily intended for those students who wish to obtain an elementary knowledge of the physiological processes occurring in the human body. The object is therefore to provide for the requirements of the college course, embracing those of the nursing schools as well as those of the dental and agricultural students. The claims of the medical students have not been forgotten. As a text-book in the physiological instruction it is very serviceable, and it forms an excellent basis for those desiring advanced courses leading to experimental investigations. The book is written in a clear and easy style and is profusely illustrated with figures. The treatment of the subject-matter follows the usual orthodox method. The chapters on digestion, metabolism and nutrition, the endocrine glands and the physiology of nerve and muscle and the nervous system embody information derived from the recent advances in our knowledge. But the last chapter dealing with the physiology of reproduction might have received a fuller treatment, with references to the fundamental principles of genetics and heredity. In an elementary text-book of this character, one would naturally expect to find a chapter devoted to the consideration of personal hygiene and public sanitation which legitimately fall within the scope of physiological text-books. Every student must possess a fairly decent and correct knowledge of the origin and development of man, the functions of the organs in health and in disease, the mechanism of inheritance of characters and the imperative necessity of hygienic habits so necessary in the interests of the individual concerned and of the society. However the book provides the ordinary requirements of the college students who will doubtless greatly appreciate the purpose which it is intended to serve.

The Rock-skipping Fishes of the Blenniid Genus *Andamia* from the Andamans

ON the rock-bound and coral boulder-strewn coasts of the Andamans are little-known fishes called the Blennies and Rock-skippers living in shallow rock-pools or on the rocks between tide-marks subject to the action of breakers. The family Blenniidæ to which the Rock-skippers and Blennies belong has a wide distribution in tropical and temperate seas. Their small size and unattractive sombre colours, and their being of no economic importance have attracted very little attention to the members of this family in spite of their wide distribution. The Blennies and Rock-skippers are easily recognised by their slender elongate body, strongly developed fan-shaped pectoral fins near the neck-region, the much-reduced more or less fleshy ventral fins, the long and continuous dorsal fin, and the smooth scaleless body. The males of certain species have fleshy crests on the head. In an excellent paper on the Ecology and Bionomics of the Blenniid Fishes of the genus *Andamia* of the Andamans, published in the *Records of the Indian Museum*, XL, pp. 377–93, pls. viii–x (1938), Dr. H. Srinivasa Rao has made a valuable contribution to our knowledge of the little-known habitats and habits of two species of *Andamia*, one of which is described as new to science by Dr. S. L. Hora (*loc. cit.*, pp. 393–400). The two species of *Andamia* live in the same localities in situations which are only a few feet apart, the older species, *Andamia heteroptera*, in crevices and fissures of rocks or on exposed surfaces of isolated rocks swept by waves or kept constantly moist by the spray from the waves, and the new species, *Andamia raoi*, on the face of rocks exposed to the full force of the breakers from the open sea. The latter species is less well-adapted to a terrestrial existence than the former which is capable of living out of water during the low-water period with only a trace of moisture retained in its minutely corrugated skin. Both the species live in groups of not less than four or five, often in larger groups of ten or more. In open bays studded with rocks or coral boulders constantly bathed by waves, *A. heteroptera* keep moving with the tides jumping on to rocks not completely submerged by the sea. The dislodgement of the fish from their positions on the rocks by the powerful currents and waves is prevented by the action of a curious fleshy cup-shaped sucker on the lower side of the chin and by the fan-shaped pectoral fin. Besides the active movements of the fish such as skipping, skimming and swimming, the author describes its progression on rock-surfaces by the flexure of its tail, and various other curious voluntary movements.

The Rock-skippers feed mainly on minute algæ growing on rocks which they scrape with the help of their fine golden yellow teeth. The great length of the intestine shows that they are vegetable feeders.

The study of the behaviour of the ever-active Rock-skippers in their natural environment having presented considerable difficulties, the author succeeded in keeping them in aquaria for periods up to a month and observing them under various experimental conditions to which he subjected them in the Laboratory. These fish, it was observed, could not survive desiccation for more than three hours as when the moisture on the skin dried up they began to collapse. The author has pointed out that the minute ridges and grooves on the head, operculum and parts of the body may serve to retain moisture for a much longer period than if the skin were smooth. Although the fish bask in the sun in their natural haunts for short periods, it would appear that the moisture content of the skin determines the period up to which they can suffer desiccation. Nor can the fish survive prolonged immersion in the sea-water as atmospheric air, not air dissolved in water, is essential for their life under the conditions prevailing in the intertidal region. The Rock-skippers although terrestrial in their habits are fully

adapted for aerial respiration in the presence of moisture, but under adverse conditions can remain alive for short periods through aquatic respiration in which the organs of aerial respiration seem to subserve aquatic function as well. The spacious opercular chamber and the well-developed gill-lamellæ and pseudobranch appear to be the important factors concerned in this increased capacity for aerial respiration. The gradual dilution of sea-water in which the fish live has little effect on them, but in fresh water they show considerable distress and die in about two hours.

The breeding season of *Andamia*, judging from the occurrence of young ones in nature throughout the year and of eggs under laboratory conditions from September to March, seems to be fairly extended and almost continuous. Some of the stages of embryonic development observed in the Laboratory have been described.

The most interesting point in the observations recorded is that, of the several species of Blenniid fishes which inhabit the intertidal region in the Andamans, two have reached a higher stage in the evolution of the air-breathing habit by leaving the relatively stable environment of the rock-pools and acclimatising themselves to the unstable but better aerated conditions of the spray and surf which bathe the rocks on which they live. Of these two species, *Andamia raoi* occupies a lower rung in the ladder of evolution as it is unable to live far away from the open sea while *Andamia heteroptera* has advanced further in its adaptation to a relatively more terrestrial habitat.

OBITUARY

Dr. T. S. Narayana, M.Sc., Ph.D.

DR. T. S. NARAYANA comes of a family of reputed scholars.—His father is Mahamahopadhyaya Kalaprapurna Dr. Tata Subbaraya Sastri of Vizianagaram. Educated at the Maharajah's College, Vizianagaram, and the Hindu University, Benares, he worked for three years at the Indian Institute of Science, Bangalore, as a Madras Government Research Scholar under the direction of Prof. H. E. Watson. Thereafter he did research in the laboratories of the Andhra University and was serving as a Lecturer in Chemistry in the P. R. College, Cocanada, at the time of his death.

Dr. T. S. Narayana

His published work relates to the Budde Effect in Halogens and is very widely appreciated—extensive references to it are to be found in recent books on Photochemistry like Plotnikov's "Allgemaine Photochemie". He was a very gifted experimenter, and a man of wide learning, not a narrow specialist. His death at the premature age of 32 has removed from our midst a physical chemist of great promise, a skilful experimenter, a popular teacher and above all a very genial friend.

Mineral and Nitrogen Content of Some South Indian Pasture Grasses

By (the late) Dr. A. S. Menon

(University Biochemical Laboratory, Chepauk, Madras)

OF the inorganic constituents constantly found in the animal body the following are now known to perform important metabolic functions: iron, calcium, magnesium, manganese, copper, sodium, potassium, chlorine and iodine. Their indispensability in nutrition is well recognised in practice, in the scientific feeding of farm animals in European countries. But as Sir A. D. Hall[1] has written: "In various parts of the world, cases have been found from time to time of deficiency diseases in grazing live-stock due to the lack of particular minerals in the soil and consequently in the herbage. As a rule, these troubles are found in the old countries only through long-continued grazing of uncultivated pastures, or in the newer countries where grazing has been attempted without consideration of the specific deficiencies of the soil." Both these conditions are prevalent in India and there is reason to believe that malnutrition leading to high mortality, sterility, and low milk yield due to mineral deficiency in pastures is widespread in India. (For a summary see Orr.[2]) The nutritional efficiency of Indian pastures appears, however, to have been little investigated from this point of view. Aiyer and Kayasth[3] working on the mineral composition of fodders in the Central Provinces and Bihar found that the grasses grown in these areas are deficient in phosphorus and calcium. The calcium, phosphorus and nitrogen content of certain varieties of hay and straw have been recorded by Warth, Viswanath Iyer & Krishna Ayyar,[4] and Viswanath Iyer & Krishna Ayyar.[5] Ramiah[6] has made a study of the seasonal variations in the mineral and nitrogen content of spear grass.

In the present investigation a comparative study has been made of the mineral and protein contents of some common grasses from the Madras City on the east, and Malabar on the west coast of the Presidency. The two areas

TABLE I

Mineral content in terms of dry weight

Variety and place	Silica-free ash %	I γ/100 gm.	Cl %	CaO %	P_2O_5 %	Fe %	K_2O %	Na_2O %	N %
Madras									
Cyanodon dactylon	8·24	84·0	0·675	0·605	0·501	Traces	1·997	0·332	2·20
Panicum ramosum	6·25	15·4	0·868	0·948	0·682	0·102	1·832	0·243	1·41
Setaria verticillata	10·36	118·0	1·837	0·564	0·512	0·059	2·64	0·413	2·96
Chloris barbata	4·59	..	1·480	0·896	0·578	Traces	1·093	0·210	2·40
Ergrostis tenella	3·96	69·0	0·571	0·493	0·613	Nil	1·441	0·162	1·02
Ergrostis pilosa	3·02	16·4	0·214	0·435	0·411	0·067	1·722	0·198	1·71
Malabar									
Cyanodon dactylon	3·89	15·0	0·349	0·326	0·356	Traces	1·510	0·285	0·89
Panicum ramosum	4·44	30·0	0·363	0·132	0·358	Traces	..	..	1·40
Andropogan pertusus	6·71	46·0	0·553	0·515	Traces	Traces	1·831	0·222	1·59
Rice Straw (i)	4·50	11·0	0·615	0·325	0·096	0·037	1·690	0·202	0·35
Rice Straw (ii)	2·20	11·0	0·384	0·248	0·027	0·077	1·262	0·154	0·45
British Isles (From Orr, 1929)[2]									
Cultivated pasture	6·64	..	0·95	1·00	0·74	..	3·18	0·25	2·83
Natural pasture	5·85	..	0·64	0·65	0·67	..	2·66	0·37	2·50
Poor hill pasture	5·49	..	0·60	0·56	0·60	..	2·60	0·41	2·54

present striking differences not only in climatic and physical features, but also in the quality of the live-stock, the cattle on the hilly wet regions of the west coast where green grass is available practically throughout the year being notoriously poor in quality both in size and milk yield compared to those on the dry eastern plains; a mineral deficiency in the soil caused by the heavy rains and reflected in the composition of the herbage provides an extremely probable explanation of the poor quality of the Malabar cattle.

The Madras grasses were obtained from the outskirts of the City and the Malabar samples either from Kollengode (a hilly tract near Palghat or from Calicut. The samples were cut in the months of August and September immediately after the grasses had come to flower. Identification was kindly carried out by Prof. K. Ekambaram of the Presidency College, Madras.

The following constituents were determined on nine common grasses and two varieties of straw: silica-free ash, iodine, chlorine, calcium, phosphorus, iron, sodium and potassium. Determinations of nitrogen were carried out at the same time as the protein content is also known to be a factor dependent on the state of the soil.

The methods of analysis were those of the Association of official Agricultural Chemists (1935) with the following exceptions: iodine was determined by von Fellenberg's method as described by Harington[7], nitrogen according to Pregl, and phosphorus according to Fiske and Subbarow.[8]

Conclusions

Taking into consideration only the most important constituents, *viz.*, calcium, phosphorus, potassium, sodium, silica-free ash and nitrogen for which standards of comparison are available, it is obvious from Table I that all grasses analysed are poor in quality, only one of the samples, *viz.*, *Panicum ramosum* from Madras showing a mineral content even approximately equivalent to that of good quality natural British pasture. This species contain adequate amounts of silica-free ash, calcium, phosphorus and chlorine, but is deficient with respect to potassium, sodium and protein. The deficiencies in *Setaria verticillata* are such that this grass would be a suitable supplement to *Panicum ramosum*.

Comparing the grasses from the two localities with each other the west coast varieties are seen to be very much inferior in essential minerals to those grown in Madras; this is strikingly brought out in the case of the two species *Cyanodon dactylon* and *Panicum ramosum* which are common to both groups. The Malabar grasses are particularly deficient in calcium, phosphorus, iodine and protein.

The two kinds of rice straw from Malabar are characterised, as was to be expected, by a mineral content which is extremely low compared even to the grasses from the same locality.

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[1] Hall, Sir A. D., *The Feeding of Crops and Stock*, (John Murray, London), 1937.

[2] Orr, Sir J. B., *Minerals in Pastures* (Lewis, London), 1929, p. 112.

[3] Aiyer and Kayasth, *Agriculture and Live-stock in India*, 1931, **1**, 526.

[4] Warth, Iyer and Ayyar, *Ind. J. of Vet. Sci. and Anim. Husb.*, 1932, **2**, 325.

[5] Iyer and Krishna Ayyar, *ibid.*, 1934, **4**, 108.

[6] Ramiah, P. V., *ibid.*, 1933, **3**, 65.

[7] Harington, *The Thyroid Gland*, Oxford University Press, 1933.

[8] Fiske and Subbarow, *J. Biol. Chem.*, 1925, **66**, 375.

Effective Phosphates in Cane Juices

By S. N. Gundu Rao and Kripa Shankar

(Imperial Institute of Sugar Technology, Cawnpore)

ALTHOUGH the importance of the phosphate content of juices in determining their behaviour towards clarification is generally recognised, the exact phosphate requirements reported by different authors vary within wide limits (Walker,[1] McAllep and Bomanti[2]). Some have concluded (Lanier[3]) that the initial colloid content is more responsible for the efficiency of clarification than the phosphate content itself.

In Natal, where the juice colloids are high and the soil deficient in phosphates, the P_2O_5 content of juices is raised to 0·05–0·06 per cent.[4] to secure good clarification. The work of Keane and Hill[5] on the filtrability of raw cane sugars, of Carrero[6] on P_2O_5 contents P.O.J. 2878 juices, of Beater[7] on South African juices and of McRae[8] on the nature of the phosphates present, shows that the entire phosphorous in the juices is not available for clarification. The authors believe that it is only the phosphate which is in true solution or which gets into solution on heating which reacts with the added lime to form the calcium phosphate precipitate; this portion of the phosphate is known as the *effective phosphate*.

The Separation of 'effective' and 'non-effective' phosphates.—The 'effective' phosphate was dialysed out through a cellophane membrane, at 80° C. against distilled water, employing a muslin-filtered sample of juice (50 c.c.) obtained by crushing in a three roller vertical mill, under moderately heavy pressure. 50 c.c. of the juice is then separately analysed for total phosphates.

The dialysate in the beaker is collected and

TABLE I

	Variety	Total P_2O_5 gm./litre juice	Dialysable P_2O_5 (Effective P_2O_5)	
			P_2O_5 gm./litre	% Total P_2O_5
I (*a*)	CO. 312 ..	0·5850	0·5446	93·09
(*b*)	CO. 231 ..	0·4284	0·4149	96·85
II (*a*)	CO. 312 ..	0·5874	0·5754	97·96
(*b*)	CO. 331 ..	0·4751	0·4648	97·83
III (*a*)	CO. 312—			
	Top ..	0·6076	0·5861	96·46
	Bottom ..	0·8150	0·7875	96·63
	Whole ..	0·6942	0·6761	97·36
	CO. 331—			
	Top ..	0·5116	0·4984	97·42
	Bottom ..	0·7505	0·7370	98·20
	Whole ..	0·6130	0·5998	97·85

replaced by fresh distilled water daily in the initial stages and later on, on alternative days. The dialysis was continued for 7 days, with daily changes of water; all the dialysate was collected, concentrated, evaporated to dryness with a few drops of calcium acetate, ashed and the P_2O_5 estimated gravimetrically by precipitation as ammonium phosphomolybdate. The results obtained with two varieties, on different dates, on the whole juice and juices from top and bottom portions are given in the table.

The above figures reveal that in the varieties examined the effective phosphate is more than 95 per cent. of the total phosphate. This is in disagreement with the results of most of the earlier workers, who obtained by their methods 50–70 per cent. of the total phosphates as possibly being available for defecation. It will also be noticed that the effective phosphate is more in the bottom juice than in the top juice. Whether these differences are common to all the Indian varieties and at different periods of growth or due to milling conditions or to defects in the methods of determination—these are factors now under investigation.

[1] Walker, H., *Ind. Eng. Chem.*, 1923, **15**, 104.

[2] McAllep and Bomanti, *Hawaiian Planters' Record*, **26**, 122.

[3] Lanier, "Process," *4th Annual Conf. of Association Sug. Tech.*, Cuba, p. 93.

[4] Farnell, *Int. Sug. Jour.*, 1929, p. 149.

[5] Keane and Hill, *Ind. Eng. Chem.*, 1931, **23**, 421.

[6] Carrero, *Rept. Agric. Expt. Station*, Puerto Rico, Mayaguez, 1931, p. 11.

[7] Beater, *Proc. South African S. Tech. Association*, 1937, p. 82.

[8] McRae, *ibid.*, 1929, p. 54.

Chemical Reactions Involving Solids

THE structural elements of matter in a solid possess but little mobility at ordinary temperatures, compared to a fluid state, so that one would on superficial considerations even hesitate to regard solids, as such, to be involved in chemical reactions. Indeed this concept prevented for a remarkably long time any appreciable interest being taken in the chemistry of the solid state, although technical processes and particularly work on metallography had shown that under favourable conditions solids do possess a characteristic reactivity. This chemical reactivity of a solid is in particular evident when the other reacting component is a fluid, as in the combustion of carbon, reactions of graphite, reduction of oxides, etc. Reactions in which solid phases are exclusively taking part are also not uncommon: only, these cases are to be met with in different regions of chemical studies such as metallography, solid solutions, and Industrial Chemistry, and thus they escaped a general correlation. Consequently the principles underlying the reactions of solid bodies are very much less known and understood than those relating to reactions in the gaseous phase. The first important monograph on chemical reactions involving solids, "Diffusion und Chemische Reaktion in Festen Stoffen" by Prof. W. Jost, appeared in 1937. The 86th Symposium* organised by the Faraday Society in April 1938 has now helped to bring together various aspects of the subject, for a general discussion.

* *Trans. Farad. Society*, Part 8, 1938, pp. 821, 1085.

It is but natural that the general physical principles underlying these reactions should come up first for consideration. In the first two papers by N. F. Mott and J. C. Slater, the energy levels in crystal lattices, and the motion of electrons and of "positive holes" are discussed, and it is explained how the "excitation" can be transmitted over finite distances by the transfer of energy from one atom to the next. Succeeding papers deal with the conduction, diffusion, and chemical changes in solids. In the phenomena of electric conduction, and in a number of reactions involving diffusion processes, it is interesting to study the mechanism of the movement of the material ions. It is generally regarded that these movements are possible when there are deviations from the strict order of an ideal lattice. According to Wagner, some ions can exist interstitially within the normal lattice, and some positions of the normal lattice may be vacant. Motion is then possible by the jumps of the ions into the neighbouring vacant points or into the neighbouring interstitial positions. When the temperature is not too low, there is a thermodynamic equilibrium of the interstitial ions and the vacant places with the whole lattice. The energy of disorder in the ionic crystals has been discussed by W. Jost. In another interesting paper by J. D. Bernal, on the geometrical factors in reactions involving solids, it has been emphasised that the one common principle which runs through the whole field of such reactions, is the tendency to preserve crystal orientation

and atomic positions as little changed as possible.

The other contributions to this symposium, which are studies of specific reactions, are grouped as Part II and under three sections: (A) Photochemical reactions, (B) Chemical decomposition of solids (including detonation) and reactions between solid phases, and (C) Reactions of solids with gases and liquids, with particular reference to solid carbon.

Photochemical processes proceeding within the simplest of solid substances, namely, the halides of alkali metals, are of fundamental interest, and crystals of greatest chemical purity can be prepared and investigated photochemically. R. Hilsch and R. W. Pohl have proceeded further by using these crystals as solvents for substances of a similar chemical nature, and observing the photo-reactions in the latter. Thus KH in solid solution in KBr decomposes upon absorption of one light quantum ($\lambda = 228$ $m\mu$), to produce a neutral K atom, and the latter is bound in a peculiar way in the lattice producing *Farbzentren*. Processes of more immediate interest in the art of photography are next considered in a series of six papers by J. Eggert, F. Weigert, C. F. Goodeve, Dr. Luppo-Cramer and others. It is essentially due to the presence of *"störstellen"* (impurities, irregular spots) in the crystal lattice, that silver bromide exhibits its photosensitiveness. This is particularly so in the region of wavelengths longer than about 500 $m\mu$. In a photo-sensitised process, which is distinguished from a direct photo-process, the essential feature is the transfer of energy from the spot where it is absorbed to one where an emission or a reaction can take place. C. F. Goodeve and J. A. Kitchner have studied the photosensitisation in solids for a number of cases. The term 'exciton' introduced by Frankel to describe the quantum after absorption by an atom, ion, or molecule, is very convenient in considering such transfer of the absorbed energy in solids. In the extreme, the 'exciton' may be a free electron, giving rise to pronounced photo-conductivity.

Equilibria of the type solid (1) $\rightleftharpoons$ solid, (2) + gas have been known for a long time but a close study of these reactions has been made only recently, and particularly after the realisation of the essential interfacial character of these reactions. The reactions most closely investigated have been the dissociation of metallic carbonates, and the dehydration of solid hydrates. The formation and growth of interfaces have been studied by W. E. Garner and others. J. Zawadzki describes how various types of spurious equilibria arise in the decomposition of solids, due to sorption, and to the slow rate of crystallisation of the nucleii. The thermal decomposition of certain substances is of an explosive nature, and a study of these explosive detonations has led to the general view that they are initiated by the simultaneous decomposition of a number of neighbouring molecules in the lattice. The rate of propagation of the detonation wave in the crystal is of the order of 4000–7000 metres per second, *i.e.*, the wave travels at about the maximum speed at which thermal vibrations could be transmitted from one ion to another. In an aggregate of explosive material, however, W. Taylor and A. Weale regard that the decomposition follows quite a different mechanism. Here a narrow reaction zone passes through the material with velocities ranging from 1,500 to 10,000 metres per second. A very rapid decomposition takes place in this zone under the action of the impulsive forces in the pressure wave and is primarily due to the grinding together of the granules of the explosive and consequent tribochemical action.

As is well known, solid carbon exists in the three forms, diamond, graphite and amorphous carbon. The reactivity of the two latter phases is extensive and provides very interesting studies. The hexagon layer planes of the graphite crystal lattice behave as molecular entities and have properties closely resembling those of the triaryl methyls. They form layer lattice compounds such as the alkali graphites, and ferrous graphite on the one hand, and graphite monofluoride, and graphite bisulphate on the other, indicating the amphoteric nature of the hexagon layer planes. In these compounds, the hexagon layers persist and the compounds formed are ionic in nature. These reactions are naturally facilitated or hindered by the degree of accessibility of the hexagon layer surfaces. H. L. Riley finds that according to the conditions under which a carbon has been prepared, small amounts of hydrogen or hydrocarbons are present which influence the accessibility of the graphite hexagon layers to the reactant. The finely dispersed active carbons represent a distinct amorphous state according to O. Ruff, and have increased reactivity on account of the large number of lattice faults and consequent large number of free valencies. Activated carbon has found in recent years a number of varied uses. Unlike silica and alumina gels, active carbon is hydrophobic and has, therefore, the advantage that the humidity in gases and vapours which have to be treated does not effect the adsorption capacity considerably. E. Berl has reviewed the formation, properties and specifications of activated carbons.

The last group of papers deal more intimately with the reaction between oxygen and carbon. The strong free valencies on the surface of carbon due to unsaturation at the edges of the graphite crystallites, etc., hold the oxygen atoms by covalent bonds, *i.e.*, by "chemi-sorption". Strickland-Constable puts forth the suggestion that these surface oxides of carbon are definite compounds having a considerable variety of possible structures and atomic constitutions. The kinetics of the simultaneous production of CO and CO_2 during these combustions is explained by L. Meyer and V. Sihvonen through the formation of single keto- and β-diketo groups on the boundary atomic chains of the graphite layer molecules.

There are a number of other interesting papers in this volume, of which an adequate account cannot be given here. The book as a whole is a veritable mine of useful data and informations. It is priced at 12/- with paper covers.

M. A. GOVINDA RAU,

Agriculture and Animal Husbandry in India

THE report of progress in agriculture and animal husbandry in India during the year 1936–37, issued under the authority of the Imperial Council of Agricultural Research, affords as usual a comprehensive summary of agricultural development in all its aspects and forms, like its predecessors, a very useful book of reference to all those interested in the agriculture of this great country. Progress has been so many-sided and scientific activities so numerous that it is no easy task to make a connected and comprehensive narrative of all of them in their due perspective, but the Council has succeeded very well in the attempt. The report, however, relates to work which is now nearly two years old, and though the delay is somewhat unavoidable, one wishes that some arrangement may be made by which future reports can be published without such a long interval elapsing. The information is grouped and dealt with along the same lines as in former reports, with the exception that more attention is devoted to "Fruit development" and "Fodder crops and grazing", which are each given a special chapter.

Considerably more money was made available for agricultural research and development during the year; the total gross expenditure for the whole country rose by Rs. 18 lakhs for agriculture and by Rs. 5 lakhs for veterinary science. The Central Government also made a special grant of the large sum of Rs. 2·82 crores for rural development out of which agriculture has had its due share. The year was notable for the visit of Sir John Russell and Dr. N. C. Wright to India to examine and report on the work carried on by the Imperial Council of Agricultural Research. The recommendations contained in their reports which are of a far-reaching character, are summarised in this report, but the action taken or proposed to be taken in respect of these recommendations which are really what would interest one more, do not come within the purview of this report. As regards the adoption of improvements by cultivators, notable progress has been reported in the cultivation of improved varieties of the various crops; the area under such varieties rose from 21·4 million acres in 1935–36 to 23·9 million acres in 1936–37, though this by no means represents the whole extent of such increase. Extensive and well-organised schemes of seed distribution following on crop improvement work by all the departments, central and provincial, continued to make steady progress. Similar progress is reported in respect of fertilisers; the import of chemical fertilisers rose from 72,210 tons to 83,653 tons in the year. Though the consumption of sulphate of ammonia rose from 57,164 tons to 76,360 tons, the share of local production was only 17,748 tons. Local production indeed recorded a slight fall from 17,851 tons to 17,748 tons. One would wish to see the day when India's requirements of phosphatic and nitrogenous fertilisers at least will be fully met from Indian production. In respect of improved implements progress has been moderate, but the redeeming feature is that they are of Indian manufacture, a development which is showing encouraging signs of expansion. Progress in well-boring operations and the installations of pumping sets for irrigation makes interesting reading, both in the variety of operations and in the success that has attended them. In respect of crops aside from the various manurial, cultural and crop improvement investigations, those relating to "quality" deserve special mention and results of considerable practical value are already reported in respect of one, *viz.*, rice. This line of work is eminently worthy of expansion so as to embrace other crops as well and more of their "quality" characters. Questions relating to fodder and grazing were the subjects of discussion at three conferences in the year at which forest grazing, improvement of grasslands, better utilisation of waste lands and kindred matters were gone into and a recommendation made for the establishment of a central and provincial fodder and grazing committees for paying special attention to these matters. Under "Fruit development" the results of work on cold storage being conducted in Poona are notable, their practical application in the fruit trade of the country will no doubt soon follow. Progress is reported in many fields of animal husbandry especially in respect of the supply of breeding bulls. A compilation of the type characters of certain important breeds of cattle and buffaloes was arranged for in the year. Many of the numerous investigations under crops, pests and diseases, dairying and cattle improvement were in varying stages of progress and many of them are referred to in broad outline. Forty schemes were completed and there were as many as 136 schemes in the course of investigation at the end of March 1937—a fact which shows that after all agricultural research is not altogether neglected in India. The chapters on agricultural education, veterinary education, District-work and agricultural co-operation give relevant information for the year under report and a number of appendices furnish much statistical details.

A. K. Y.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*Madras University Library, and Secretary, Madras Library Association*)

Hollings, John (1683–1739)

JOHN HOLLINGS, a British physician, was born at Shrewsbury in 1683. His father was an M.D. Having attended the local grammar school, he joined the Magdalene College, Cambridge, in 1700 and became a Fellow of the Royal College of Physicians and of the Royal Society in 1726. He eventually became Physician-General to the Army.

Hollings was reputed to be a man of considerable culture and scholarship. His only book entitled *Status humanee naturœ expositus in oretione corum medicis Londinensilus habita* was his Harveian oration of 1734.

Hollings died May 10, 1739.

Davies, Thomas (1792–1839)

THOMAS DAVIES, another British physician, was born in Carnarthenshire in 1792. He was apprenticed to his maternal uncle who was apothecary to the London Hospital. While practising independently a few years later, he had symptoms of pthisis which made him go abroad. He prosecuted his medical studies in Paris and learnt the new art of ausculation from its inventor, Laennec. Having got his M.D. degree in 1821, he returned to London where he set up private practice and disseminated what he had learned from Laennec by delivering courses of lectures at his house. This brought him some recognition and led to his appointment as lecturer at the London Hospital.

His lectures on the diseases of the lungs and heart were first published in the *London medical gazette* and later as a book. This book gave a faithful exposition of the discoveries of Laennec.

Davies died of chest disease May 30, 1839.

Graham, John (1805–1839)

JOHN GRAHAM, an amateur British botanist of India, was born in Dumfriesshire in 1805. He came to India in 1826 and was soon appointed Deputy Postmaster-General of Bombay.

He was also put in charge of the Botanical Gardens of Bombay. In this capacity, he enriched the collections of that Garden to a considerable extent. He began a catalouge of Bombay plants which was completed and published posthumously by J. Ninmo, as Graham died suddenly at Khendalla May 28, 1839.

Cooper, Thomas (1759–1839)

THOMAS COOPER, a British scientist of America, was born in Westminster, October 22, 1759. He was educated in classics while at Oxford. But later, while his father intended him for Law, he took a clinical course in the Middlesex Hospital and established practice at Manchester. He later practised as a lawyer. However, his scientific attainment warranted his nomination to the Royal Society by his friend, Joseph Priestley.

After involving himself in political matters for sometime, he got disgusted with the practical working of democracy and migrated to America. There he became a friend of Jefferson and after active political life for some years, he was elected to the chair of Chemistry in Carlisle and later in the University of Pennsylvania. In 1820 he changed over to South Carolina College. He was a prime factor in the establishment of the first school of medicine and the first lunatic asylum in the State.

The influence of Cooper on his generation was mainly through his versatile and prolific pen. He wrote much on law and political science. His *Lectures on the elements of political economy* (1826) was the first of its kind. His *Institutes of Justinian* (1812) and *Statutes at large of South Carolina* are monuments of his legal learning.

His scientific writings were also equally important and voluminous. He edited the *Emporium of arts and sciences,* published treatises on a variety of subjects like dyeing, calico-printing, gas lights, and edited several European text-books in chemistry. His description of the scientific discoveries of his friend Priestley (1806), his *Introductory lecture on chemistry* (1812) and his *Discoveries on the connection between chemistry and medicine* (1818) were justly famous and far ahead of the ordinary state of knowledge of his times.

Cooper died May 11, 1839.

ASTRONOMICAL NOTES

Planets during June 1939.—Mercury will be in superior conjunction with the Sun on June 7 and will be visible as an evening star about the end of the month. Venus can still be seen as a fairly bright object near the eastern horizon for about an hour and a half before sunrise. It continues to get closer to the Sun and is becoming fainter. On June 17 there will be a close conjunction of the planet with the Moon. Mars reaches the meridian at about 3 a.m. and is well placed for observation during the latter part of the night. On June 24, it will be at one of the stationary points of its apparent orbit. The planet is increasing considerably in brightness, the stellar magnitude being $-2{\cdot}0$ at the end of the month.

The major planets Jupiter and Saturn continue to be visible as morning stars; the former rises about an hour after midnight and can be seen as a bright object (mag. $-2{\cdot}0$) in the early hours of the morning. The ring ellipse of Saturn is gradually getting wider, the angular dimensions of the major and minor axes being $38''{\cdot}0$ and $10''{\cdot}0$ respectively, about the middle of the month. Uranus is also a morning star and will be situated about 2° to the south of the star δ Arietis (mag. 4·5). A close conjunction with the moon will occur on June 15 and will be helpful to observers in locating the planet.

Comets.—Pons-Winnecke's Comet is visible as a faint object (of magnitude 13 on May 10) and is moving slowly in the constellation Bootes. Information has been received of the discovery of a bright Comet (1939 d) on April 18 by Hassel at the Oslo Observatory. At the time of discovery the Comet was of the third magnitude and is reported to have had a nucleus and a short tail.

It has become fainter since then and has been moving rapidly in a south-easterly direction in the constellations Perseus and Taurus. An orbit computed by Möller gives 1939 April 10 as the date of perehelion passage.

Kopff's periodic comet was re-discovered on April 22 by Prof. Van Biesbroeck at the Yerkes Observatory. It appears to have been a faint and diffuse object without central condensation or nucleus.

T. P. B.

SCIENCE NOTES AND NEWS

The Drainage of India.—Dr. S. L. Hora has made an important contribution (*Proc. Nat. Inst. Sci. India*, 1938, 4, No. 4) on "Changes in the Drainage of India as evidenced by the Distribution of the Freshwater Fishes". Dr. Hora has, by this and other publications, pointed out the zoogeographical importance of the Indian fish fauna and thus made the study of Ichthyology more interesting. It has been clearly shown that the distribution of both past and present-day freshwater fishes constitute an important criterion for the elucidation of the palæohydrographical features of land masses. A brief geological history of India is given. A main drainage of the Upper Gondwana period has been indicated by the presence of the Dipnoan and the Ganoid fishes in the Kota-Maleri beds in the Godavari valley. Based on the occurrence of the estuarine fishes in infra- and inter-trappean beds of the Central Provinces, it is concluded that during pre-trappean period a main river flowed towards Rajputana. Further it is pointed out that during the post-trappean period the drainage of the Peninsular India was reversed. That the modern bony fishes particularly the Siluroids had become dominant as early as the Siwalik period is evidenced by their remains among the Siwalik rocks. Based on the distribution of fishes Dr. Hora supports the view of the existence of 'Indobram' or 'Siwalik' river.

Further Dr. Hora contends that freshwater fishes originated in Southern China and from thence spread to all directions. A close similarity between the fish fauna of the Peninsular India, Eastern Himalayas, Burma, S. China and Malay regions is shown. The occurrence of forms like *Bhavania* and *Silurus* in the hill streams of the Western Ghats indicates that they must have migrated from the Assam hills *via* the Satpuras by a series of river captures. The publication of Dr. Hora's article on the fish remains of the Central Provinces, to which reference has been made in this paper, is keenly awaited.

* * *

The Indo-Brahm or the Siwalik River.—At the ordinary monthly meeting of the Royal Asiatic Society of Bengal, held on Monday, 1st May 1939, Dr. Baini Prashad presented a paper on the Siwalik River, the occurrence of which during the Tertiaries was postulated in 1920 by Sir Edwin Pascoe of the Geological Survey of India, as a result of his study of the Punjab Oil Belt. The headwaters of the river corresponded with those of the Brahmaputra. "Through Assam the river flowed westwards and north-westwards along the foot of the Himalayas as far as North-West Punjab, and then turning southwards along a course, not very different from that of the modern Indus, it emptied itself into the Arabian Sea. Almost simultaneously Dr. G. E. Pilgrim of the Geological Survey, from a study of the Siwalik Conglomerates, communicated a paper to the *Asiatic Society*, in which he suggested that there was a single westwardly flowing river, the Siwalik River, in place of the Indus, the Ganges and the Brahmaputra River systems, which served for the drainage both of the eastern and western Himalayas. Both the authors did not refer to the earlier communications by

Oldham (1894) and Kobelt (1899) in which similar views had been put forward." Dr. Baini Prashad discussed the zoological evidence in support of the existence of such a river system.

* * *

Indian Museum Fish Gallery.—One of the interesting additions to the newly arranged fish gallery is the Air-breathing fish of India. Of these one is the well-known *Koi* fish of Bengal (*Anabas*) which possesses two special chambers developed above the gills for the storage of air, each chamber acting as the 'lung' of the fish. Other types exhibited are the snake-headed fish, *Sol, Sauli, Lata*, etc. (*Ophicophalus*), *Magur* (*Clarias*), *Singi* (*Heteropneustes*), and *Cuchia* (*Amphipnous*). The various structures responsible for aerial respiration are shown by dissected models.

The need for using atmospheric air directly seems to have been necessitated by occasional droughts of varying duration which impelled the fish to live in stagnant waters deficient in oxygen. It was in response to such circumstances that a number of fish came to the surface to make use of the vastly greater quantities of oxygen in the air. The kinds of devices employed by the fish for using atmospheric air are so varied that it seems probable that this habit was independently acquired by a number of them.

To create interest in the food fish of India the *Zoological Survey of India* has put up a special exhibit of the principal food fish of the Calcutta markets in the Fish Gallery of the Indian Museum. Actual stuffed specimens or models of as many as 28 varieties of fishes are shown.

Attention is directed to the fact that the available supply in the Calcutta markets is far from sufficient and only a small percentage of the total quantity offered for sale in the Calcutta markets is from local fisheries. Most of the freshwater fish are imported from Southern and Eastern Bengal and the Chilka Lake, the estuarine fishes come from various parts of the Gangetic Delta, while the marine forms are imported from Puri and other sea-ports.

* * *

Prince of Wales Museum of Western India, Bombay.—The Report for the year 1937–38 recently issued, gives a brief outline of the activities of the Museum. A new wing (opened by H. E. Sir Roger Lumley, G.C.I.E., D.L., Governor of Bombay, on March 17th) was added during the year, at a cost of Rs. 2½ lakhs. On the ground floor of this wing, are displayed the collections of the Natural History Section in attractive settings in a manner which reflects a striking improvement in museum exhibition in India. At the same time, the attractiveness and educational value of the exhibits have been greatly enhanced.

The Report draws attention to several interesting investigations conducted by the staff. Mention may be made of the Man-eating Hyænas from the United Provinces. The Curator's investigations show that the common Hyæna may resort to man-eating when pressed by hunger due to shortage of natural food. Once established in an individual, man-eating may become a tradition passed on from mother to offspring, and attacks on human beings may recur until the particular stock that has acquired this trait is exterminated.

Among the Acquisitions to the Natural History Section, mention may be made of a fine specimen of Bewick's Swan (*Cygnus bewickii*) presented by E. S. Lewis, Rajpore, Delhi. A breeding colony of the little Tern (*Sterna albifrons albifrons*) was discovered by Mr. Humayun Abdul Ali in a small island near Bombay. Messrs. Ali and McCann have obtained fine specimens of the birds and eggs.

It would be impossible to mention the several activities of the three sections of the Museum, the Arts section, the Archæological section and the Natural History section, in this note. The number of visitors to the Museum has averaged over 21,000 a day, when open to the public free of charge. After the new wing was opened, the number has appreciably increased. The Report points out that the new wing provides only for public galleries; there is, however, pressing need for providing accommodation for research collections, library, office, work rooms and lecture hall, and it is hoped that generous-minded wealthy citizens of the Presidency and the Government will come forward to provide necessary funds to enable these additions, so essential for the Museum, to be made.

* * *

Madras Fisheries Department.—To an impoverished country like India, whose large tracts suffer from frequent visitations of famine and whose populations are afflicted from malnutrition, it is a matter of paramount importance that the food resources of the sea should be explored and harvested. The importance of developing fisheries in India has been frequently emphasised in the columns of *Current Science*.

The administration report of the Madras Fisheries Department for the year 1937–38, which has been recently published, reveals the various lines of useful work carried out by the department. Of particular interest are the technological researches relating to deep sea fishing methods, fish manures, prawn pickling, and the vitamin survey of fish oils. Some of the oils particularly from certain kinds of shark, have been found to be exceptionally rich in their vitamin content. It is to be hoped that these encouraging results will be soon commercially exploited.

* * *

Haffkine Institute.—In addition to the routine production of large quantities of prophylactic vaccines, the Haffkine Institute is establishing itself as a producer of new knowledge under the direction of Col. S. S. Sokhey. The Annual Report for the year 1937, which has been recently issued, records several lines of investigation which are being persued at the Institute. Researches relating to the several aspects of plague and its vaccine by Col. Sokhey and his collaborators, Pharmacological studies of anti-malarials by Dikshit and his collaborators, researches relating to certain diagnostic constants of blood, investigations on snake venoms, and a study of the cultural requirements of the plague bacillus, constitute some of the useful

lines of investigation which have yielded promising results. It should be a matter for satisfaction to the Director that the Institute has not only attracted a number of voluntary workers but also secured generous support from the Indian Research Fund Association for most of the above researches.

* * *

Quality of Digitalis Preparation sold in India.—A representative survey of the digitalis preparations sold in India carried out by the *Biochemical Standardization Laboratory*, Calcutta, has led to the finding that a large proportion of the preparations is below par. Digitalis preparations are extensively employed by Physicians in the treatment of heart diseases. The Laboratory collected some 110 samples (102 tinctures and 8 powders) from all provinces of British India and analysed them by the 'Intravenous Cat Method' recommended by the British Pharmacopœia. As many as 87 preparations were below 80 per cent. in strength and 57 were below 50 per cent. potency. 102 samples in the group were of Indian origin and 8 of foreign make. It is suggested that all digitalis preparations issued for sale should be tested and their potency controlled before they are released into the market. Strict precaution should be enjoined regarding their storage in cool and dark places, preferably in cold storage and all digitalis tinctures more than a year old should be retested for their potency and if below par, withdrawn from clinical use.

* * *

Survey of India.—Full details of the Survey Operations of the ordinary field units, as well as, of map publications and instrument manufacture for the year 1938, are now compiled from the General Report of the Survey of India recently issued. The report also gives an abstract of the other volume "The Geodetic Report" containing full details of all scientific work.

The earliest maps of India prepared by Major James Rennel, the first Surveyor-General of Bengal in 1767, were originally military reconnaissances and latterly chained surveys based on astronomically fixed points and from these beginnings, this department has gradually become primarily responsible for all topographical surveys, explorations and the maintenance of geographical maps of the greater part of Southern Asia and also for geodetic work.

During the year under report, the area surveyed was 38,559 square miles. The report gives an abstract of the geodetic operations including the measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, seismological and meteorological, gravity determinations in all parts of India and predictions of tides at 41 eastern ports between Suez and Singapore. The longitude of Dehra Dūn has been determined by the bi-weekly transit observations; latitude observations at Agra show surprisingly large variation as was also found at Dehra Dūn.

The re-adjustment of the primary and secondary triangulation has been completed so far as it is at present contemplated to take it, until circumstances make it possible to adopt the International Spheroid instead of Everest's which is unlikely to happen for many years to come.

The probable errors of the primary and secondary triangulation have been investigated and it is found that the length and breadth of India have been measured with probable errors of about 1 part in 500,000 or of 20 feet in 2,000 miles.

Investigations have been made regarding the anomalies of magnetic force associated with underground bodies of magnetic rock. At 48 stations in Bengal, S.W. Baluchistan, the Punjab and Rajputana, observations to determine the force of the gravity were made. In co-operation with the Geological Survey and the Burmah Oil Company the effect of known geological abnormalities on intensity of gravity is being studied.

Observations for latitude and longitude were made at 49 stations along a line running southwards from near Mandalay to near Victoria Point and these observations confirm the existence of a very large southerly rise of the geoid in this area.

The old triangles of the Assam Longitudinal Series between Gauhāti and Goālpāra were reobserved.

An abstract of topographical work is given in Part 3 of the Report. The tables A, B and C indicate the progress in the topographical survey programme and contain details of the work done during the year. Table A indicates the area of survey completed since 1905 as well as what remains over to complete the contoured Topographical Survey of India, Table B shows the area revised during the year and Table C ennumerates in detail the survey operations carried out during the year under report.

The Survey of India, from the year 1905, concentrated on the preparation of a new series of modern topographical maps in several colours on the 1 inch to 1 mile scale; this new series is meant to meet the demand for more detailed information to be shown on maps, especially as regards the portrayal of hill features by contours, proper classifications of communications and more recently of air traffic requirements. This series intended to be completed in twenty-five years, is only two-thirds completed by 1938, full progress having been deterred by the outbreak of the War and other circumstances. Though every year, thirty to sixty thousand square miles of area are surveyed, the maps of a large part of the country are still over fifty years old.

Air survey work for civil purposes is also receiving a good measure of attention and continuous research is being carried on, in the latest methods of mapping from photographs taken from the ground and in the air. Photographic methods have been employed for the survey of about 1,600 square miles of area. An air survey of Bettiah Town has also been undertaken.

The last part of the report details the progress of map publication to date. Progress of publication to date, of a standard series of modern maps, excluding transfrontier work is indicated in Index maps C to G at the end of the report. All publications and map issues for the year, the fair drawing carried out by the

various drawing offices and field parties and the working of the printing and miscellaneous offices are indicated in this part of the volume.

The Mathematical Instrument Office has continued to do increasingly useful work, the manufactures and repairs covering a wide range of scientific instruments. During the year there has been a considerable increase in the value of stores issued and in the output of the work.

C. G.

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Mustard and Rape Seed Industry in India.—A recent publication issued by the Indian Industrial Research Bureau (A Study of Indian Mustard and Rape Seed and their Oils, *Bulletin* No. 13, Manager of Publications, Delhi, 1938. Price 14 annas) draws attention to the present mustard and rape seed industry in India. Technical data on which an All-India Standard Specification for mustard oil may be based, are presented and it has been shown that mustard oil of equal pungency and of superior yield to that given by the indigenous *ghannis*, can be obtained from modern plant when suitably operated.

The possibility of identifying seeds of different Brassica species by the microscope examinations of their seed-coat structures, has been indicated and the factors controlling pungency and the improved milling methods for the extraction of oil are discussed.

Since there is a strong tendency to adulterate this oil, difinite specifications have been fixed by the different Provinces. These values have been compared with those of the oil extracted from the pure seeds, and it is concluded that certain mustard oil specifications in force in India need modifications to admit genuine oils. Certain specifications are also recommended.

In the last chapter the authors deal with pungency and the oil mill technique, "pungency in edible mustard oil", they conclude, "depends on hydrolysis of the glucoside present in the seed, and the optimum temperature for the reaction is between 40°–45° C.". They have also shown "that if mustard seed is pressed in a *ghanni* or in any other type of machinery without being moistened, or if the seed is heated about 70° C., the oil obtained lacks the essential mustard smell". It was found that the modern oil milling plant can be used to produce pungent oil, if operated according to the improved methods described in the *Bulletin*.

The publication will prove useful to the Oil Mill owners who wish to utilize their modern plant in extracting pungent mustard oil of commerce. To the plant breeder and botanist the knowledge of the seed-coat structure of different *Brassica* species and *Eruca sativa* illustrated by photographs will be of immence value.

R. H. R.

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The Imperial Bureau of Plant Breeding and Genetics, Cambridge, has recently issued a bulletin on "The Action and Use of Colchicine in the Production of Polyploid Plants" (by J. L. Fyfe, Price 1*sh.*). The discovery of the action of the drug colchicine on nuclear division, making it the most reliable agent yet used in the production of polyploid plants, has excited great interest even in laymen and is of importance to those working on the cytology or genetics of plants. The bulletin begins by explaining the chromosome doubling; next a detailed account of the action of colchicine on mitosis and meiosis is given, followed by summaries of the results obtained from the use of colchicine for producing polyploid plants. The action and use of acenaphthene, which the Russian workers have shown to be a similar agent to colchicine, are also described. Particular attention has been paid throughout to treatments and dosages and some recommendations are given which should be helpful to those contemplating the production of polyploids. All the literature appearing up to the end of January 1939, is included and listed in a bibliography of 38 references.

* * *

Guiding Principles for Studies on the Nutrition of Populations.—The Health Organisation of the League of Nations has just published a handbook entitled *Guiding Principles for Studies on the Nutrition of Populations* by Professor E. J. Bigwood, of Brussels University. (Ser. L.o.N.P., 1939, III, I, 281 pages. Price 6/-, $1·50.)

The author has endeavoured to work out methods of enquiry which can be generally applied as to the actual food consumption and the state of nutrition of given population groups. The handbook is divided into two parts: (A) *Dietary Surveys*: There are four types of dietary survey: investigations may extend over a whole country, or be limited to population groups, to families, or to individuals.

The author describes the technique of these surveys—weighing methods; method of records in household books—questionnaire method, etc.; he then deals with the analysis of the collected data from the standpoint of the physiology of nutrition and with the scales of family consumption coefficients which have to be used in comparing the results of enquiries concerned with groups of different age and sex composition. The last two chapters of Part I deal with diets from the economic standpoint and the statistical significance to be assigned to the results of surveys. (B) *Enquiries into the State of Nutrition of Populations*: In this part of his handbook, the author discusses the somatometric (biometric, clinical and physiological) methods that may be suitably employed in these investigations. Special attention is given to the physiological methods, especially those for detecting latent hypovitaminoses and iron deficiency.

The handbook is completed by examples of surveys of various types in a number of different countries; it also comprises a terminological index and bibliographical references.

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The Child Welfare Information Centre of the League of Nations has just issued *The Summary of the Legislative and Administrative Series of Documents of the Child Welfare Information Centre* unblished in 1938 (*Ser. L.o.N.P.*, 1939, Vol. 1, pp. 58. Price 1*sh.*)

"A glance at this publication shows what questions have been engaging the particular

attention of Governments in the last few years. It will be seen, for example, that the protection of neglected and delinquent children has made fresh progress in nine countries, and that the small number of countries which inflict corporal punishment on minors has been further diminished, since New Zeland has amended her legislation so as to abolish whipping inflicted by order of the Children's Courts.

"In another direction it will be observed that the United Kingdom has made a bold innovation in the legislative sphere by investing the local authorities of the large towns with the power to close certain streets for traffic at certain hours in order that they may be utilised as playgrounds. The effects of this measure will be felt both as regards the prevention of juvenile delinquency and that of the protection of children against the physical dangers of the streets.

"A number of countries make no distinction between the protection of children and the protection of families. In this connection the Uruguayan law of April 19, 1938, authorising the constitution of "homesteads" and laying down the conditions attaching thereto is a document of great interest."

* * *

Naturalistic Measures in the Control of Malaria.—The latest issue of the *Bulletin of the Health Organization* of the League of Nations (No. 6) is mainly devoted to rural life problems. Drs. Heckett, P. F. Russell, J. W. Schraff and Senor White have discussed in an interesting article, the present use of naturalistic measures in the control of malaria. "In including this problem, the Malaria Commission of the League of Nations had in mind the questions raised by rural malaria in poor countries. The article deals with the first step towards the solution of the problem by critically surveying all action taken so far on naturalistic lines. This is defined as "the deliberate extension or intensification of natural processes which tend to limit the production of mosquitoes or their contact with man". The authors stress the desirability of creating experimental centres and of ascertaining the cost of methods before applying them".

* * *

A study of the Jute apion has been undertaken at Dacca in the Agricultural Research Laboratory of the **Indian Central Jute Committee**. A survey of the low land areas in the Rangpur District revealed that young seedlings were attacked by a number of pests and diseases. The jute apion does not appear to have been previously recorded at such an early stage. To study their life-history, the jute apion and the indigo-caterpillar are being reared in the Laboratory. From the diseased material, species of Rhizoctonia, Fusarium and Alternaria have been obtained.

* * *

The creation of a separate government department in order to undertake research on earthquakes is urged in the Memoir on the Bihar-Nepal Earthquake of 1934, just issued by the Geological Survey of India. The subject is too specialised to be regarded as requiring the occasional attention of the meteorological department and the Geological Survey. The work could be more thoroughly and authoritatively studied by whole-time specialists. There are two lines of investigation awaiting such a department: (*a*) the prediction of future earthquakes as to time and place, and (*b*) the means of minimising their effects. "From a scientific and engineering view-point, the whole of North India within, say, 200 miles of the foothills of the Himalaya, must be regarded as a region particularly susceptible to severe earthquakes". Evidence exists for postulating the constant movement of the Himalaya throughout tertiary times down to the present day, a movement directed laterally towards the peninsula and giving rise to great horizontal thrust planes. On the Peninsula in Chota Nagpur, there has been a succession of upward movements during Tertiary times, giving rise to a general tilting towards the north. In the Gangetic Plains between, there has been constant subsidence. It is believed that all these movements are related. In the downward folded zone of the Gangetic Plains between the two uplifted regions of the Himalaya and the Peninsula, a state of strain or potential fracture is presumed to exist.

* * *

We understand that the Locust Research Scheme of the Imperial Council of Agricultural Research, which has till now been located at Karachi under the Locust Research Entmologist, has now been difinitely closed. In view, however, of the importance of continuing the work of watching the deserts in the Indian area for locust developments and of warning the Indian cultivator about locust invasions in advance, the Government of India have sanctioned, with effect from 1st April 1939, the establishment of a "Locust Warning Organisation" under the supervision of the Imperial Agricultural Research Institute, New Delhi, for which the services of a good part of the staff of the late Locust Research Scheme have been retained. The desert staff is to be controlled by a Superintendent stationed at Karachi.

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The Twenty-first Anniversary of the **Bose Institute** was also the first Memorial Meeting for its illustrious Founder, Sir Jagdis Chandra Bose, who dedicated this Institute to the Nation on his fifty-ninth birthday, November 30, 1917. Sir Nilaratan Sirkar, in his Presidential Address, gives a very interesting summary of Bose's life and work, and points out that the Bose Institute is the "first and foremost among his gifts for the advancement and diffusion of knowledge. ..... This unique Institution, with its potentialities, should form an invaluable asset to the Nation, provided we knew how to utilise it." Sir Nilratan concludes with a quotation from Bose's inaugural address delivered on the Foundation Day of the Institute, a masterpiece of Bose's poetic imagination, literary skill and dynamic philosophy.

Dr. D. M. Bose, the present Director of the Institute, gives an outline of the work now being carried on at the Institute in plant physiology, plant genetics, agriculture, biochemistry, zoology, anthropology, and the chemical analysis of soil, food-stuffs, and the active constituents of Indian medicinal plants. The Physics

Laboratory of the Bose Institute has been enlarged for investigations in spectroscopy, ultrasonics, natural and artificial radioactivity and cosmic radiation. In co-operation with the Departments of Physics and Applied Mathematics of the University College of Science, Calcutta, the Institute conducts a lively Colloquium on Nuclear Physics.

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Mr. P. M. Kharegat, C.I.E., I.C.S., lately Secretary, Industries and Education Department, United Provinces, has succeeded Sir Bryce Burt, C.I.E., M.B.E., I.A.S., as Vice-Chairman, Imperial Council of Agricultural Research.

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The Maynard-Gangaram Prize for the year 1939 has been awarded to Rao Sahib Ch. Ram Dhan Singh, M.A. (Cantab.), Cerealist, Punjab Agricultural College, Lyallpur, in consideration of his meritorious work on the breeding of new wheat varieties.

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Cawnpore Sugar Technology Institute.—The annual report of the Imperial Council of Agricultural Research for the year 1937–38 gives details of the training facilities provided by the Cawnpore Sugar Technology Institute. It will be remembered that the Institute was established by the Government of India in October 1936, on the recommendations of the Tariff Board and the Sugar Committee, for a period of five years. It undertakes research on (1) Problems of Sugar Technology in general and those of sugar factories in India in particular; (2) Utilisation of bye-products of the industry; (3) Detailed testing of new varieties of cane under factory conditions; and (4) General problems of sugar engineering and chemistry.

To meet the demand for specialised technical staff for work in sugar factories, the Institute trains students in all branches of Sugar Technology and Sugar Engineering and arranges for refresher courses for men already employed in industry. In Sugar Technology and Sugar Engineering, a three years' course for the diploma of I.I.S.T. is provided. Graduates in Physics, Chemistry and Mathematics, Mechanical or Electrical Engineering are eligible for admission. Twelve admissions are made each year.

The Sugar Boilers' Certificate course is open to candidates who have passed the Intermediate Examination in Science or any equivalent examination. It is a one-year course; after two years, experience in Pan-boiling, the student becomes entitled to the certificate. Twelve admissions are made each year.

Three admissions are made yearly for post-graduate research in the sugar technology section and three in the sugar engineering section. The course extends to two years during the non-working period of cane factories and two seasons' factory experience after qualifying for the associateship. The diploma of F.I.I.S.T. is the highest Government diploma of Sugar Technology or Sugar Engineering in India.

Arrangements have also been made for short courses on a variety of subjects relating to Sugar Industry for candidates who do not possess the necessary technical and academic qualifications for the higher courses. These include a two sessions' course on Chemical Control and Bacteriology and a one session course on Pan-boiling, Fuel and Boiler control, Statistics (for sugar students), statistical methods (for research students) and training in Dutch and German languages. The sessions are usually held during the sugar off-season, so that actual employees in sugar factories may not be at a disadvantage. The general qualifications required for short courses are a B.Sc. degree with Chemistry, and some practical experience in a sugar factory. A high school leaving certificate is the minimum qualification for a Pan-boiling course, for the course on Statistics (for sugar students), the candidate is required to have passed the I.A. or I.Sc. with Mathematics as one of the subjects.

The Institute grants two scholarships of Rs. 25 per month each, one for the Associateship Course in Sugar Technology and the other for the Associateship Course in Sugar Engineering.

An employment bureau assists the ex-students of the Institute in finding jobs in Sugar Factories.

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University of Mysore.—I. *Lectures*: Under the Scheme of Extension Lectures, Mr. V. L. D'Souza, B.A., B.com., delivered a lecture in English on "Population and Production" at each of the places, Shimoga and Bhadravati.

II. *Meeting of the Senate*: The annual meeting of the Senate was held on the 31st March 1939. Among the propositions that were passed, mention may be made of the following:—(1) Holding the Final Examination for the M.B.B.S Degree twice a year; (2) Removal of the condition of a pass in the Intermediate examination in the case of candidates who hold the L.M.P. Diploma of Mysore and who seek admission to the Pre-Medical Course; (3) Holding the University examinations in future in February and March instead of March and April commencing from 1940, the University session commencing on 1st June instead of on the 24th; (4) Recommendation to the University Council to take necessary steps for affording the University students every opportunity for obtaining Military Training on suitable lines; (5) Recommendation to the University Council for the deputation of two members of the University staff in the cadre of Assistant Professor of English to England for higher studies in English Language and Literature; (6) Recommendation to the University Council for taking all necessary steps for establishing an Intermediate College at a mofussil centre to be selected by the Council; (7) Opening of a 'University Adult Literacy Campaign' in connection with Rural Reconstruction Centre now located by Government at Closepet.

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Enquiry into the Cultivation of Cloves in India.—The subject of this enquiry, *viz.*, cloves, is one of those important agricultural products of commerce about which little is known. It was a welcome attempt on the part of the Imperial Council therefore to have instituted the present survey which not only brings out the very gratifying fact that cloves are already growing in the country and that the conditions of soil and climate in certain parts are quite suitable for its cultivation but also brings

together a comprehensive mass of information bearing on all aspects of the cultivation methods as carried out both in this country and in the more important centres of cultivation outside such as Zanzibar, Madagascar, Ceylon, and the Dutch East Indies (Report of an Enquiry into the Cultivation of Cloves in India by A. K. Yegna Narayan Aiyer, *Misc. Bulletin*, No. 20, Manager of Publications, New Delhi, 1938). An interesting account is given of the great attempts of the old East India Company to introduce the cultivation into India from the Dutch East Indies and thereby break the monopoly which the Dutch enjoyed in respect of this costly and valuable product, in those far off days of the struggle for supremacy in the trade with India and the orient generally. A description is given of the clove groves to be found in India, and for the sake of comparison of the clove groves in Ceylon, the descriptions being illustrated by photographs. The present trade in cloves in India is reviewed, there being an import annually of some 62,000 cwts. valued at about forty lakhs of rupees, though in a peak year the imports rose to over 73,000 cwts. This gives an idea of the scope there exists for local production. The soils of the present clove areas in India and those of the Ceylon areas for comparison have been analysed and these elaborate data form an important feature of the survey. Nursery practices, varietal characteristics, manuring, pests and diseases, harvesting and curing methods are dealt with in detail. With the exception of the fact that at the young stage the plants are delicate and are difficult of establishing, the cultivation appears to present no difficulties. Experimental cultivation on an area of about one hundred acres in the different eligible centres is suggested, as well as a study of various methods of propagation for overcoming the initial difficulties and securing other advantages. It is now up to the Imperial Council to follow up this commendable beginning with definite practical steps for the starting of the cultivation in the centres spoken of as suitable in the Report.

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The Composition and Agricultural Value of the Fine Ejecta of Volcanic Eruptions.—The eruption of the Mayon Volcano in the Philippine Islands in the month of June 1938 was taken advantage of to determine the chemical and physical composition of the ejecta and its agricultural value by N. L. Galvez (*The Philippine Agriculturist*, 27. Nos. 9 & 10). Seven samples were examined, six of which were similar in texture to ordinary soils, while the seventh belonged to that class of ejecta called lava. The chemical composition of the latter was found to be almost identical with the former, which analysed as follows:—SiO_2 56·36, TiO_2 0·78, Al_2O_3 19·37, Fe_2O_3 8·23, MnO 0·4, CaO 8·50, MgO 1·13, K_2O 1·16, SO_3 0·40, P_2O_5 0·56 and loss on ignition 0·72. The lava differed materially from the other ejecta only in the loss on ignition and the Fe_2O_3 contents which were 0·20 and 7·80 respectively. Analysed for their agricultural value, the six samples contained on the average (in the portion soluble in 10 per cent. HCl) among other constituents the following:—Al_2O_3 4·67, Fe_2O_3 1·53, CaO 2·17, MgO 0·20, K_2O 0·07, Na_2O 0·57, P_2O_5 0·10. One of the samples contained a trace of nitrogen while the others, including the lava, contained nothing of this constituent. The insoluble residue was high, *viz.*, 88·76. The amount of available K_2O was low while that of available P_2O_5 higher than for ordinary soils. The fine ejecta is hygroscopic and acidic in reaction and the leaves of abaca (*Musa textilis* Nee) and papaya (*Carica papaya* Linn.) on which the ejecta settled became scorched and wilted, in consequence. Though the samples were all devoid of any nitrogen, they contained (collected two weeks after the eruption) colonies of bacterial growths of moulds and sulphur-oxidising organisms, while nitrifying and azotobacter organisms were absent. A. K. Y.

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Announcements

Seventh World's Poultry Congress and Exposition.—The Seventh World's Poultry Congress and Exposition will be held at Cleveland, Ohio (U.S.A.), from July 28 to Agust 7, 1939. Immediately before and after the Congress, a series of tours to various parts of the country will be arranged for visitors. It is the desire of the General Congress Committee that National Committees be formed as soon as possible by all countries expecting to participate in the Congress. Each National Committee will serve to organize the representation of its country at the Congress and to maintain contact with the United States Organization.

The following five sections will comprise the Scientific Sessions: (1) Genetics and Physiology; (2) Nutrition and Incubation; (3) Pathology and Disease Control; (4) Economics, including Processing and Marketing; and (5) General.

All communications regarding the Congress should be addressed to W. D. Thermohlen, Secretary General, Seventh World's Poultry Congress and Exposition, United States, Department of Agriculture, Washington, D.C., U.S.A.

All-India Obstetric and Gynecological Congress, 1939.—The Third All-India Obstetric and Gynecological Congress will be held in Calcutta in December 1939. The principal subjects of discussion are (1) anæmia of pregnancy, (2) functional uterine hæmorrhage, and (3) maternity and child-welfare. The Provisional Scientific Committee have formulated a scheme to facilitate investigations on these subjects. All communications are to be addressed to the Secretary, Dr. S. Mitra, M.D., F.R.C.S., F.R.C.O.G., 3, Chowringhee Terrace, Calcutta.

A New "Nomenclator Zoologicus."—Professor Julian S. Huxley, Secretary, Zoological Society of London, writes:—The preparation of this work, respecting which an announcement was made in 1935, is now approaching completion. It constitutes an attempt to bring together the names of all the genera and subgenera in Zoology that have been described from the 10th edition of *Linnaeus*, 1758, up to the end of the year 1935, with a bibliographical reference to the original description of each. It will also

include the great majority of alternative spellings that have appeared during that period. Another feature that will, it is thought, be found valuable for systematists relates to cases where a new name has been proposed for a homonym. In these instances a cross-reference is given under the homonym to the new name.

It is estimated that the work will comprise some 225,000 entries, of which about 5,000 appear to have been omitted from all previous publications of this character. It is proposed to publish the work in 4 volumes of nearly 1,000 pages each, which it is hoped it will be possible to issue at intervals of about six months.

The Zoological Society of London has already borne the whole cost of preparation (approximately £1,800), but the Council of the Society does not feel justified in incurring further expenditure in respect of this enterprise, which would involve an additional £3,600.

However, with the aid of various grants from outside sources, the Editor, Dr. Sheffield Neave, has himself now been able to arrange for the printing and publication of the work. It is proposed to publish it at the low advance-subscription rate of six guineas post free for the four volumes, provided that a sufficient number of undertakings to subscribe can be obtained. (Intimation may be sent to Dr. S. A. Neave, O.B.E., Imperial Institute of Entomology, 41, Queen's Gate, London, S.W. 7.) If these are adequate, it is hoped to issue the first volume during the coming summer. After publication, the price will be raised to eight guineas.

Messrs. *The Veritas Press*, Inc., New York, announce that they will soon be publishing a comprehensive Thesaurus of Geology and allied scientific terms, under the authorship of Walther Huebner. The publication, which is the first of its kind in the history of geological literature, will explain and co-ordinate more than 25,000 geological terms in the English and German languages, covering exhaustively all branches of the subject. The price of the book, which will contain about 400 pages, will be $7·50, and the English-German Part is expected to be published in October 1939.

Considering the nature and scope of the work we have no doubt that this compilation will be welcomed, and its value appreciated, by geologists all over the world, who wish to be familiar with English and German geological literature.

Messrs. *Annual Review*, Inc., Stanford University, P.O. California, announce that the *Annual Review of Biochemistry*, Vol. VIII, 1939, will be ready by July 15, 1939. The volume will contain approximately 680 pages and is priced $5·00 per copy.

The non-profit Bibliofilm Service (*Bibliofilm Service*, U.S. Department of Agriculture Library, Washington, D.C.) copies, at cost, for serious research workers, extracts from almost all publications, except certain of those which are copyrighted) abstracted in *Chemical Abstracts*. Present rates are 1 cent per page plus a fixed service charge of 20 cents for copying in the form of microfilm (35 mm. standard safety photographic film conveniently usable in reading machines now widely available at moderate cost), or 10 cents per page, plus service charge of 20 cents, for copying as photoprints 6″ × 8″, readable without optical aid). When properly copyable material is not available in the four great scientific libraries where Bibliofilm Service has installations, it is usually borrowed from other institutions for copying, or copies through other services or in other cities at their somewhat varying rates (*Chemical Abstracts*).

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We acknowledge with thanks, receipt of the following:—

"Agriculture and Live-Stock in India," Vol. 9, Pt. 2.

"Journal of Agricultural Research," Vol. 58, Nos. 3–5.

"Agricultural Gazette of New South Wales," Vol. 50, Pts. III–IV.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 3.

"Biochemical Journal," Vol. 33, No. 3.

"Berichte der deutschen chemischen geselschaft," Vol. 72, No. 4.

"Journal of the Institute of Brewing," Vol. 45, No. 4.

"Journal of the Indian Botanical Society," Vol. 18, No. 1.

"Biological Reviews," Vol. 14, No. 2.

"Communications from Boyce Thompson Institute," Vol. 10, No. 2.

"The Journal of Chemical Physics," Vol. 7, No. 4.

"Journal of the Indian Chemical Society," Vol. 16, No. 2.

"Chemical Age," Vol. 40, Nos. 1030–1033.

"The Calcutta Review," Vol. 71, No. 1.

"Chemical Products," Vol. 1, No. 6.

"Experiment Station Record," Vol. 80, No. 3.

"Indian Forester," Vol. 65, No. 5.

"Forschungen und fortschritte," Vol. 15, Nos. 10–12.

"Transactions of the Faraday Society," Vol. 35, No. 216.

"Genetics," Vol. 24, No. 2.

"Bulletin of Health Organization (League of Nations)", Vol. 6, No. 6.

"Calcutta Medical Journal," Vol. 35, No. 5.

"Bulletin of the American Meteorological Society," Vol. 20, Nos. 1–2.

"Scripta Mathematica," Vol. 5, No. 4.

"Journal of the Indian Mathematical Society," Vol. 3, No. 5.

"Indian Medical Gazette," Vol. 74, No. 4.

"Nature," Vol. 143, Nos. 3621–3624.

"American Museum of Natural History," Vol. 43, No. 4.

"Journal of Nutrition," Vol. 17, Nos. 3–4.

"Proceedings of the Royal Netherlands Academy", Amsterdam, Vol. 42, No. 1.

"Indian Journal of Physics," Vol. 12, Pt. VI.

"Canadian Journal of Research," Vol. 17, No. 2, A, B, C and D.

"Research and Progress," Vol. 5, No. 3.

"Journal of the Royal Society of Arts," Vol. 87, Nos. 4505–4508.

"Sky," Vol. III, No. 6.

"Indian Trade Journal," Vol. 132, Nos. 1712–1714.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

April 1939. SECTION A.—R. S. KRISHNAN: *Influence of Secondary Scattering on Depolarisation Measurements.* The secondary scattering which is very pronounced in emulsions and proteins enhances the values of ρ_u, ρ_v and ρ_h. This effect can be eliminated by using a very narrow pencil of light for illumination. M. AFZAL AND V. I. VAIDHIANATHAN: *A note on Capillarity and Subsoil Water-Table.*— A large number of concave menisci formed in the interstices near the surface exert a negative pressure, and hold down the subsoil water level. S. BHAGAVANTAM AND CH. V. JOGA RAO: *Ultrasonic Velocity and the Adiabatic Compressibility of some Liquids.*—The adiabatic compressibility derived from ultrasonic velocity and determined directly on the same specimens of liquids, are found to be in good agreement. B. RAMAMURTI: *A Special Net of Quadrics.* BAWA KARTAR SINGH: *The Space Arrangements of Atoms—Part I. The Configuration of Nitrogen in the 3-Covalent State.*—It is deduced from stereochemical considerations that the nitrogen valencies are non-planar. S. RANGASWAMI, T. R. SESHADRI AND J. VEERARAGHAVIAH: *Constitution of Naringin.*—The position of the sugar group. Glucose and rhamnose exist as a disaachraride unit attached to position 7. G. R. PARANJPE, Y. G. NAIK AND P. B. VAIDYA: *Scattering of Light by Large Water Drops. Part I, and Part II.*—Mie's theory has been extended to larger sizes of particles of radius varying from $0{\cdot}4\mu$ to $3{\cdot}0\mu$. The corresponding experimental studies on steady clouds confirm the calculated angular distribution of intensity and its dependence on the particle size. P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part VIII.—Constitution of Herbacitrin and Quercimeritrin.* Herbacitrin is the 7-glucoside of Herbacetin and Quercimeritrin in the 7-glucoside of Quercetin.

April 1939. SECTION B.—B. N. SINGH, K. N. LAL AND M. B. LAL: *The Influence of Artificial Fertilisers upon the Photosynthetic Efficiency of* Andropogon Sorghum. B. N. SINGH AND S. R. A. N. RAO: *Photosynthetic Efficiency of Leaves as Influenced by Variations in pH of the Injected Solutions.* K. BHASKARAN NAIR: *The Reproduction, Oogenesis and Development of* Mesopodopsis orientalis *Tatt.* B. R. SESHACHAR: *On a New Species of* Uræotyphlus *from South India.*

Indian Chemical Society:

February 1939.—J. C. GHOSH: *The Production of Optically Active Substances and Metallic Films of Silver, Platinum and Palladium by means of Circularly Polarised Light.* TEJENDRA NATH GHOSH AND DEBABRATA DAS-GUPTA: *Pyrazole Derivatives.* S. K. RANGANATHAN: *-iso*Propylglutaconic *Acid.* V. S. PURI AND V. S. BHATIA: *The Action of Inorganic Colloids on Electrodeposition of Nickel.* B. N. GHOSH, P. K. DUTT AND D. K. CHOWDHURY: *Enzymes in Snake Venom—Part V. Detection of Dipeptidase, Polypeptidase, Carboxypolypeptidase and Esterase in Different Snake Venoms.* S. G. CHAUDHURY AND M. K. INDRA: *On Theories of Adsorption Indicators.* SURESH CHANDRA SEN-GUPTA: *Studies in Dehydrogenation—Part III.* BALWANT SINGH AND SOHAN SINGH: *Potentiometric Studies in Oxidation-reduction Reactions—Part V. Oxidation with Potassium Chlorate.* U. P. BASU AND S. J. DAS-GUPTA: *Acridine Derivatives as Antimalarials—Part II.* S. K. RANGANATHAN: *Experiments towards the Synthesis of Physiologically Active Lactones—Part I.* Cyclo*Pentyl-and* Cyclo*Hexylsuccinic Acids. Resolution of* dl-cyclo*Pentylsuccinic Acid.*

Indian Botanical Society:

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The Imperial Agricultural Research Institute

THE Scientific Report of the Imperial Agricultural Research Institute, for the year ending June 1938, records the results of work during the first year of its settled existence in its new home, after its transfer from Pusa to Delhi.

It will be recalled that when, as the result of damage to the Institute at Pusa by the devastating earthquake in January 1934, the Government of India decided to transfer the Institute to Delhi, misgivings were felt in some quarters whether owing to soil and climatic differences, the work on many important crops could be continued at Delhi from the point at which it was left at Pusa. It is gratifying to note from the report that the actual results obtained with several crops belied the apprehensions, and that the continuity of the programme of field research and experiment has not suffered by the transfer.

The Imperial Agricultural Research Institute, familiarly known as the Pusa Institute, has successfully striven, since its establishment in 1903, to advance the nation's most vital industry—agriculture—by bringing science and agricultural practice into close contact. As a central research organisation, the Institute made great and enduring contributions to the improvement of agriculture and to the scientific knowledge of the agricultural problems of the country, during the past three decades. The Institute at Pusa, being the first of its kind in the country, provided for many years the main stimulus for agricultural research. Many recent agricultural developments in the country owe their foundations to the constant care and wider imagination exercised in seeking for the directions of advance, and in giving the lead which the Institute had offered in the early days of agricultural research in India.

On the practical side, tangible economic results have accrued to the cultivator from the improvements effected by the Institute

in the fruitful fields of crop and animal husbandry. The Pusa wheats speedily earned a distinction and spread even beyond the borders of India. The remarkable development in the Indian sugar industry is due in a great measure to the planned researches conducted at the Coimbatore Station of the Institute. Coimbatore sugarcane has definitely become a household word in the sugarcane growing tracts. The work on tobacco and its flue-curing have enabled the production of tobacco leaf of the colour, necessary for the modern cigarette, and have contributed to developments in the cultivation, trade and industry of cigarette tobacco. In a previous report and in a popular account of the work of the Institute, the Director has stated, we believe on justifiable grounds, that the increase in the agricultural income to the cultivator in one year directly arising from the work of the Institute, exceeds the total amount of money spent on the Institute in thirty years.

The scientific work leading to these practical achievements is a long list of impressive scientific papers on soils, fertilisers, crops, pests and diseases, contributed mostly to the scientific publications of the Institute, popularly known as Pusa Memoirs and Bulletins.

The transfer of the Institute from Pusa to Delhi, marks a new epoch in the history of agricultural research in India, and coincides with important developments and new ventures in the science and practice of agriculture in India. There have been important developments within the agricultural industry itself. The economic significance of Indian agriculture is not now confined to the production of food crops and peasant agriculture. Power farming on estate basis and intensive cultivation are developing. Movements in marketing organisation and the introduction of grades and standards demand in agricultural produce a very high quality for trade and industry. A more recent and a very important development is the interest in national nutrition, which calls for the production of sufficient food with high nutritive value. These insist upon fresh knowledge on problems of soil fertility, cultivation and plant nutrition and in the ways of protecting crops from damage by insect pests and disease, paying due regard to the fact, as it is known now, that the nature and intensity of the processes in the soils and crops of the tropical and sub-tropical regions are different from those that obtain in temperate regions. The programme of research and investigation besides being a continuation or the corollary to the work that has been in progress requires such modifications or additions as are demanded by current problems and the trend of future developments.

In the report under review, the Director of the Institute introduces the scientific work of the year in the different sections of the Institute and gives a general survey of the nature of problems under study and the objective thereof, mainly for the information of the non-technical reader.

A perusal of the Report has convinced us that the Director and his colleagues are intensely alive to the problems of contemporary scientific agricultural practice. The active programme of research at the Institute is based on the recognition of the vital need for greater production, having regard to the increasing demands of the consumer and a safe margin for the producer; but what is important is the realisation of the fact that the degree of economic success of the agricultural industry depends on the extent to which various other subsidiary industries of the farm such as crops, livestock, implements, processing of produce,

utilisation of waste, can be blended into a harmonious whole.

Several new and interesting lines of study are described in the Report under review. The studies on the theory and practice of mixed farming are of inestimable importance to Indian agriculture as a means of maintaining soil fertility, which is the main link between land and stock. These studies have for their objective the judicious blending of crop and animal husbandry so that the land supports the animal and the animal comes to the relief of the land as far as possible. Interesting results are recorded from early maturity and early mating experiments in the investigations on cattle breeding for milk production. It would appear, from the results of experiments which have been in progress for seven years, that the progeny of early matured and early mated heifers and bulls, can in no respect be considered inferior to the progeny of animals that ordinarily mature late and, therefore, mated late, in appearance, stamina or in milk yield per lactation. This means that bringing animals to early maturity and mating them early, give a greater number of lactations, an increase in the number of calvings and a more abundant supply in the total milk yield in the animal's life. Another very striking and interesting result is that obtained from stimulation experiments. When uncovered heifers are stimulated, they yield milk with normal composition and proper nutritive value. Stimulation of the act of milking and manipulation have apparently a much greater effect than hitherto supposed.

The study of the all-important soil condition as a medium for crop growth is directed to exploring the possibilities of increasing fertiliser and manurial efficiency in crop production. Connected with this is the investigation on the nutritive value of foods and fodders as influenced by the nature and extent of nourishment given to crops, and this will reach its culminating point in the evolving of a rational system of manuring for higher crop production. Another important and interesting line of study is that on the fixation of atmospheric nitrogen in the soil by itself and by leguminous and cereal crops. A clearer understanding of the mechanism of the processes of fixation under Indian conditions and the conditions that favour it is likely to lead to methods of cheap nitrogen nutrition of soils and crops by suitable soil management and crop rotations.

New lines of work in the evolution of crops are taken up. Breeding crops for drought and disease resistance has reached a stage at which knowledge is required on the application of modern theories of heridity in the further advance on plant breeding work. These are being studied in the field and in the laboratory in connection with the problem of breeding wheats which are comparatively resistant or immune to the attack of rust disease in India, and the breeding of disease-resistant potatoes. Few achievements of the Institute are more widely known than the contributions made by sugarcane research. Particular attention has been directed to the production of canes suited to the requirements of the sugar industry both in regard to quality and quantity. A very notable line of work in sugarcane breeding is the hybridisation between bamboo and sugarcane. It is perhaps too early to visualise the economic possibilities of such crosses, but the fact remains that a new line of work has been opened up, which may have a far-reaching effect in course of time.

It is one thing to grow better and more

crops, and it is a different matter to protect the crops from the ravages of insect pests and diseases and to gather the harvest in full. Ecological studies on insects, and surveys of important diseases of crops and breeding and testing of crops for disease-resistance are new lines of work, aimed at controlling insect pests and diseases of crops. Particular attention was paid during the year to researches on the control of borer pests of sugarcane about which widespread concern is felt in the cane-growing tracts.

While the Imperial Agricultural Research Institute, as its name implies, is well known for its research activities, it is not adequately realised that it is both an educational as well as a Research Institute. It gives post-graduate courses for higher instruction in different branches of agricultural sciences. During the year under report ten post-graduate students successfully completed their course and qualified for the Diploma of the Associateship of the Institute, and three completed one year course in Farm Organisation and General Farm Engineering, while four students were admitted for short periods of study in special subjects. The provision for post-graduate instruction at the Institute is a wise step, for the demand for research should be met by a steady supply of trained workers. It is only fitting that, in an agricultural country like India, the supply of trained workers should come from an institution within the country.

In opening the Institute on 7th November 1936, H. E. the Viceroy, whose solicitude for agricultural development and everything that pertains to the improvement of the village population is well known, concluded his address with the following significant words:—

> "The Institute has in it, I am confident, the power for further service of infinite value to India; alike to the Provinces and to the Indian States. Its tradition and its reputation are those of established distinction. It has been served by many able and distinguished men with a loyal and disinterested devotion throughout the many years of its existence. I am confident that the present staff will amply sustain the past record of the Institution for scientific achievements of the highest standard. In to-day declaring open its new home I do so with the wish, which all of us share, that, under its new auspices, its future may even be more brilliant and the service it renders to India even more distinguished than ever before."

Under the distinguished administration of the present Director and with the active and energetic co-operation of his loyal colleagues, the Institute has already fulfilled the ardent wish of H. E. the Viceroy, and the more beneficent results of successful scientific experiment which the Institute may yet produce will, besides enhancing its prestige, make momentous contribution to national well-being and prosperity. India's wealth is its soil, its pillars are the villager and his cattle. Science must arm the one with knowledge and protect the other in the production of more wealth. This task is as arduous as its responsibilities are great. We confidently rely on the inspiring guidance of the Director and the devotion of his staff for results which would ensure the steady and increasing prosperity of the agricultural population.

SIR RICHARD GREGORY, Bt., D.Sc., F.R.S., LL.D., F.R.Met.Soc., F.Inst.P.

Sir Richard Gregory, Bart, F.R.S.

WHEN it was decided in 1932 to produce for India a general scientific journal which would command the interest and support of the leading men of science of the country, it was natural that the originators of the project should turn to editors of journals of similar character outside India for advice and help. As a result, Sir Richard Gregory, of *Nature*, Dr. Arnold Berliner of *Die Naturwissenschaften*, and Dr. J. McKeen Cattell of *Science*, agreed to become corresponding editors of *Current Science*. The interest that Sir Richard Gregory then showed in the new Indian journal has continued in the years that have followed; and his retirement at the end of last year from the editorship of *Nature* is an appropriate occasion on which to review his services to science, in India and elsewhere. As his successors on *Nature*, we welcome the invitation of the editor of *Current Science* to attempt such a survey.

To a large extent, the story of Sir Richard Gregory's work for science is bound up with the history of *Nature* during the past forty-five years. He joined the journal in 1893 as sub-editor to Sir Norman Lockyer; but before that he had been a contributor of occasional notes, while he was working at the Royal College of Science as a research assistant to Sir Norman Lockyer. In those early days, as he himself has said, his interests were divided roughly in the ratio of three parts astronomy and one part general science. He was associated at the Royal College of Science with men like T. H. Holland, better known as Sir Thomas Holland, formerly Director of the Geological Survey of India and at present Principal and Vice-Chancellor of the University of Edinburgh, and H. G. Wells, whose reputation as a writer of scientific romances—many of which have proved almost prophetic—and of sociological works, is world-wide. Early efforts at scientific journalism took the form of notes of scientific progress contributed to weekly and monthly magazines. With Sir Richard's appointment to *Nature*, however, his activities began to extend to wider fields. Astronomy began slowly to give way before his growing interest in scientific progress in general. Nevertheless, Sir Richard has always retained his special interest in astronomy, though he would be the first to admit that it no longer holds its early place in his affections.

Sir Richard joined *Nature* at a time when a new era was opening up in science. Lord Rayleigh had recently completed his work on the density of nitrogen, and in association with Sir William Ramsay, traced the discrepancies he observed to the presence in the atmosphere of a hitherto unknown gas, argon. This discovery led to the examination of other sources of nitrogen, with the result that Sir William Ramsay, by means of the spectroscope, found in the mineral cléveite a gas which proved to be identical with an element discovered by Sir Norman Lockyer in the sun twenty-six years earlier and named by him "helium". In 1896, came the discovery of X-rays, by Röntgen, radium was discovered by Pierre and Mme. Curie in 1898, and shortly afterwards the work of Sir J. J. Thomson on the cathode rays, which showed that they consisted of a stream of swiftly moving units of negative charge which were christened "electrons".

The twentieth century began with the tide of discovery in the new sub-microscopic and sub-atomic physics running strongly. Developments during the years that followed have led to complete revision of our views on the structure of matter and on the fundamentals of physics and chemistry and also of biology. *Nature*, under Sir Richard's guiding mind, has played a notable part in this progress, many of the steps of which were first announced in its pages. The well-known section headed "Letters to the Editor" now occupies four times the space it did in the nineties of last century, and it is a recognized place for recording the progress of scientific investigations. The growth of this part of *Nature* has been due in no small degree to Sir Richard's own wide knowledge of science and friendship with its disciples. Keen and critical himself, he has always been willing to give a sympathetic ear to a scientific worker who has honestly attempted a piece of research, and, so far as considerations of space permitted, he has given him the opportunity of describing his results for the information and attention of others. Destructive and discouraging criticism have always received a swift repulse.

This same kindly yet fearlessly judicial mode of approach has characterized the whole of Sir Richard's conduct of *Nature*. In leading articles, controversial issues have been brought forward and lines of action suggested, but always with the object of

advancing science and its application to human affairs. In reviewing books and other publications, he enlisted the aid of leading workers in the subjects under discussion. By these means, he has enhanced the prestige of *Nature,* and indeed of science itself, wherever progressive and enlightened views are acceptable. His reward came in 1933, when he was recovering from a serious illness, with the announcement that he had been made a Fellow of the Royal Society, under a special Rule of the Society, which provides for the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society".

Scientific workers in India owe a particular debt of gratitude to Sir Richard Gregory. Their work has always been given careful, if critical, consideration, as indexes of *Nature* will quickly show. In this connection it is worth while recalling that the effect now known by Sir C. V. Raman's name was first announced to the scientific world in a communication from him and Prof. K. S. Krishnan which appeared in the columns of *Nature* in 1928, while the original researches of Prof. M. N. Saha and the Allahabad school have also received due notice. For many years, too, the late Sir J. C. Bose used the columns of *Nature* in bringing his many investigations, first in electro-physics and later in plant physiology, to the notice of his scientific colleagues. Support has also been given to such projects as broadcasting in India and to proposals which led to the inauguration of the National Institute of Sciences, while the activities of the Indian Science Congress Association have been followed sympathetically. Sir Richard's personal interest in Indian affairs was much enhanced by his brief but intensive tour of the country in 1933. The knowledge that he thus obtained at first hand of Indian conditions has made a deep and lasting impression on him.

So much, inadequate as it is, for Sir Richard Gregory's work for science through *Nature.* There is another side of his activities which, though equally important, has not received so much attention. His early experiences as a teacher convinced him of the important part played by suitable science text-books in schools. He set to work, therefore, to prepare text-books in which scientific methods of direct observation and experiment were given essential importance, and alone and in association with others, he has written numerous books of this kind and edited many others, all of which are marked by accuracy of statement and practical outlook. Many of these books, which have been published by Messrs. Macmillan & Co., Ltd., will be well known to students and men of science in India. As one of the founders of the *School World,* and joint editor of the *Journal of Education* with which it became incorporated, Sir Richard's influence upon educational progress is appreciated also in fields outside those of natural science.

From his early days Sir Richard has been convinced of the importance of science to the progress of civilization, and he has lost no opportunity in *Nature,* in the lay Press, and on the public platform of pointing out the contribution it can make to the welfare of mankind. For many years he played a leading part in the activities of the British Science Guild, now absorbed in the British Association for the Advancement of Science, and his latest distinction is his election as Chairman of the newly founded Division for the Social and International Relations of Science of the Association. Here he has the difficult task of steering the new Division on its maiden voyages, restraining the eagerness of the over-enthusiastic and stimulating the fearful who seek to draw back whenever science touches on political affairs. There can be little doubt that, in his experienced hands, the Division will be quickly recognised as a forum for the objective discussion of the innumerable borderland topics provided by the impact of progressive science on society.

Sir Richard Gregory, who was within a few weeks of his seventy-fifth birthday when he retired from the editorship of *Nature,* has laid the world under a debt of gratitude for his persistent advocacy of the importance to mankind of the unfettered prosecution of scientific research and its application to everyday affairs. Happily he is still vigorous in body and spirit, and his release from routine duties will enable him to devote yet more attention than in past years to the subject nearest his heart—the gospel of science.

A. J. V. GALE.
L. J. F. BRIMBLE.

Professor Walter Nernst

ON June 25, Professor Walter Nernst attains the seventy-fifth year of his life. The news will be a source of pleasure and satisfaction to his numerous pupils all over the world, and will be welcome to every body interested in science. There is hardly any scientist in this country who will not desire to join with his brother-scientists in Germany and other countries in offering Professor Nernst his warmest congratulations and in wishing him many more years of happy and active life.

It will be appropriate to the occasion to recall here some of the fundamental contributions of Prof. Nernst to Thermodynamics and Physical Chemistry. These contributions and discoveries now form an essential part of the frame-work of Physical Science and are well known to every student of Physics and Chemistry. The new "Heat Theorem" also called the third law of Thermodynamics or the principle of the Unattainability of the Absolute Zero, was first put forward in a paper published in January 1906 in the *Nachrichte der Gesellschaft der Wissenschaften Zu Gottingen.* It solved a problem which the first and second laws of Thermodynamics alone were unable to solve, namely, the calculation of Maximum work or free energy (A) from purely thermal data. The agreement between the values of A calculated on the basis of this theorem and the values obtained directly from measurements of vapour pressure, solubility or electromotive force, as also the calculations of transition points from the condition $A = 0$, provided sufficient justification for the assumptions underlying the new theorem. A direct evidence was also available in the experimental confirmation of the idea developed by Prof. Nernst in the paper referred to above, that the specific heats of all solid substances without exception assume negligibly small values at very low temperatures. The new theorem was, at first, applied to condensed system, *i.e.*, systems in which only liquids or solid substances are present. But it was later on found possible to extend it to gaseous systems also. The great utility of the extension of the theorem in this direction lies in the fact that it enables us to predict the position of equilibrium of a reaction that has never been studied experimentally. The new theorem required, for its test and application, reliable thermal data. This led Prof. Nernst to perfect methods for the determination of specific heats at low temperatures, in collaboration with Koref, Lindemann, Eucken, Pollitzer and Schwers. The result was the development of the vacuum calorimeter which has been successfully employed to obtain reliable data for the specific heats of solids and gases at very low temperatures. Incidentally, these experimental investigations yielded valuable information on the question of the general technique of low temperature work. The measurements of specific heats at low temperatures not only furnished reliable data for testing the validity of the new theorem, but also provided a foundation for the elucidation of Dulong and Petit's law and further theoretical advances in the theory of the solid state which have found expression in Debye's T^3-law.

PROF. WALTER NERNST

Investigations of gaseous equilibria at high temperatures by Prof. Nernst and his pupils and co-workers led to the improvement of old experimental methods and the perfection of new ones. Mention may here be made of the explosion method, in which high temperatures up to 3000° and even more are obtained by the explosion of a gaseous mixture in a closed bomb, the thermal conductivity method, the method of the semi-permeable wall in which platinum or iridium bulbs are employed, the method of the heated catalyst in which equilibrium is quickly attained by introducing a heated catalyst such as a platinum wire into the mixture, and the method of vapour density determinations at temperatures exceeding 2000°, in which small iridium bulbs are used. While speaking of equilibrium, one is at once reminded of Nernst's partition-law. The distribution of a solute between two liquid phases had been previously studied experimentally by Berthelot and Jungfleisch, but a thorough examination of the problem both from the theoretical and experimental aspect, was first undertaken by Prof. Nernst in 1891. Reference may also be made to his contribution to the subject of photo-chemistry. Every student of chemistry is familiar with his 'atom-chain reaction' theory which explains in a most satisfactory manner the high quantum efficiency of the reaction between hydrogen and chlorine under the influence of light.

The contributions of Prof. Nernst to the theory of solution are no less important and fundamental in character. In 1889, he put forward the theory of galvanic cells which explained the origin of electromotive force in terms of an "electrolytic solution pressure" of the metal electrodes and by a beautiful combination of kinetic considerations with thermodynamic reasoning derived an expression for the electrode potential, which is quite exact when the activity of the ion concerned can be set equal to its concentration. Other important work in this field includes investigations on diffusion in solutions, liquid contact potentials, solubility product relations and transport of water by ions.

The literary genius of Prof. Nernst has found expression in a number of writings, remarkable for their clear exposition of the subject and lucidity of style. His well-known text-book on "Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics" which was first published in 1893 and which has since appeared in a number of German and English editions, gives a masterly survey of the subject and remains indispensable to all students of chemistry. "The New Heat Theorem: its Foundation in Theory and Experiment" gives an authoritative, exhaustive and clear account of the theoretical and experimental investigations of the author and his co-workers on the subject. No serious student of physics and physical chemistry can do without this book. His "Experimental and Theoretical Applications of Thermodynamics to Chemistry" has appeared in a number of German and English editions. Besides, he has edited the *Zeitschrift fur Electrochemie,* the *Jahrbuch der Electrochemie,* and the *Zeitschrift fur Angewandte Chemie.*

It has not fallen to the lot of many to achieve what Prof. Nernst has been able to achieve in the field of Scientific Inquiry. His work which covers a wide field in physical science and extends over a period of nearly half a century, has already secured for him a high place among the scientists of all times. Let us hope and pray that he may live long to watch the results of his labours and make further valuable additions to the sum-total of human knowledge.

M. QURESHI.

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A Magnetic Study of the Oxides of Chromium and Manganese

The magnetic properties of the metallic oxides have not been investigated as completely and systematically as those of their salts. In literature the values of magnetic susceptibility reported by different workers for a particular oxide are found to vary widely and there are few precise determinations of the susceptibility changes with temperature. Thus ferric oxide which is usually paramagnetic is also reported to exist in a ferromagnetic form and the value of χ obviously depends upon the mode of its preparation. Similar variations have been noticed for nickel and cobalt oxides. The value of χ for chromic oxide ranges between 19×10^{-6} and 40×10^{-6} (Bornstein's "Tabellen") although a ferromagnetic variety has also been claimed by Faraday,[1] and Nilson & Petterson.[2] The manganese oxides behave similarly.

The susceptibility values of the salts of transition elements, in general, are in fair accord with Hund formula $\mu_B = \sqrt{4S(S+1)}$ for spin only but when the oxides are taken into consideration, the agreement is not at all good. Cameron, Harbard and King[3] believe that none of the oxides of transition metals gives values which are in accord with theory. In spite of this, it is remarkable that the order of susceptibility values of the oxides in different valency states is qualitatively that suggested by theory. These peculiarities may be due to wide deviations from the Curie Law and the present investigation on the chromium and manganese oxides was undertaken in order to see whether Weiss modification of the Law should give better concordance with theory, since the distortions produced by interatomic forces, which are principally responsible for these wide divergences, are taken account of by introducing θ in the Curie Law.

The susceptibilities of the oxides were measured between 293° K. and 580° K., on a modified form of Gouy's magnetic balance. In the main it has been possible to substantiate the following points:

(*a*) that the susceptibility value of chromic oxide obtained by (*i*) the dehydration of chromium hydroxide, (*ii*) by the ignition of chromic anhydride, and (*iii*) by the ignition of ammonium dichromate at a temperature of 800° C. is $25{\cdot}6 \pm 0{\cdot}2 \times 10^{-6}$ at room temperature. The χ, T curve, in each case, exhibits a maximum at higher temperatures, ranges between —400° and the value of θ obtained from $1/\chi$, T curve at higher temperatures, ranges between —400° and — 485°. This gives for μ_B a mean value of 3·63 which is in fairly good agreement with the theoretical value 3·87 for trivalent chromium.

(*b*) that μ_B value for monohydrate of chromium dioxide $CrO_2 \cdot H_2O$, prepared by interacting chromium hydroxide and chromic acid, is 2·95 which compares well with the theoretical

value of 2·83 for quadrivalent chromium. The value of θ for this compound is negligible. In this connection, it will be of interest to note that Cameron, Harbard and King (*loc. cit.*) have recently questioned the existence of the dioxide.

(*c*) that manganese dioxide possesses the constitution O = Mn = O. On the Hund formula the μ_B value for quadrivalent manganese is 3·87 which is in excellent agreement with the observed value of 3·73. The value of θ for the compound is — 470°.

(*d*) that manganic oxide is represented by O = Mn — O — Mn = O, since the observed magnetic moment of 5·17 Bohr magnetons is in fair agreement with the theoretical value of 4·90 for trivalent manganese. The Curie point (θ) equals — 176 for this oxide.

(*e*) that for manganous oxide the observed magnetic moment of 5·91 agrees well with the calculated value of 5·92 Bohr magnetons for bivalent manganese. Tyler,[4] and Squire,[5] from the magnetic study of the oxide at low temperatures arrived at a similar conclusion. In this compound θ has a value of — 540.

From the foregoing it is clear that after making necessary corrections for θ, the experimental μ_B values agree excellently with the theoretical, particularly for manganese oxides. It suggests, therefore, that if due regard be paid to the purity of oxides and if distortions produced by the interatomic forces are taken into consideration by determining the value of θ, then the value of μ_B obtained experimentally agrees well with theory.

Full details of this work will shortly be published.

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Thixotropy of Liquid Helium?

The object of this note is to compare the properties of liquid helium with those of a colloidal substance exhibiting the phenomena of thixotropy, with a view to point out that the transition from helium I to helium II at the λ point may be thixotropic.

The well-known phenomena of isothermal reversible sol-gel transformation is known as thixotropy. The formation of the gel can be attributed[1,2] to the constituent particles becoming locked into place in equilibrium positions, wherein the Van der Waals force of attraction is just balanced by the force of repulsion due to the mutual repulsion of the double layer. The presence or absence of electrolyte regulates the effective spheres of action of the repulsive forces by regulating the value of the ζ-potential, and hence determines whether there is completely stable suspension, coagulation or the intermediate stage of thixotropy.

This change of structure is accompanied by a change, of viscosity, elasticity, density and double refraction. Kistler[3] finds that the dielectric constant does not change appreciably and Freundlich[4] finds that the velocity of electrically charged bodies, remains unaltered even when the sol is changed into a gel. Freundlich suggests that this may be due to a local softening of the gel, under the action of the electric current and thus providing a channel for the passage of the particle.

According to Freundlich[1] 'Loose-packing' and the formation of structures caused by an equilibrium between attracting and repelling forces are common to all thixotropic systems. But the nature of these forces—whether they are due to the particles or molecules—may be very different when passing from one system to another. Hauser and Reed[5] point out that the thermal transition from sol to gel is continuous and the only difference between sol and gel appears to be mechanical, hence they conclude that during the period of gelation some type of structure with mechanical resistance to shear is being built up out of the constituent particles

of the sol. This picture postulates a two-phase system.

PROPERTIES OF LIQUID HELIUM[6,7]

In the case of liquid helium McLennan[8] finds that when the pressure above the liquid is lowered slowly, there is a sudden change in the appearance of the liquid as the λ point is passed, rapid ebullition giving way to a perfectly clear and tranquil liquid. The latent heat of transformation is less than 0·002 cal./gm., and Ehrenfest[9] calls it a phase-change of the second order.

The properties of liquid helium that change at the λ point are the thermal conductivity, viscosity, and the specific heat, whereas the specific resistance and the optical properties are not appreciably changed. Keesom and Macwood[10] are not in a position to say whether the viscosity at λ point changes discontinuously.

Keesom and Taconis[11] took the Debye-Scherrer diagram of liquid helium. Liquid helium I gave rings similar to those of other liquids. The rings for helium II suggested a face centred cubic lattice, in which half the number of atoms have been removed in such a way that every atom and every hole is surrounded by six atoms and six holes. They point out that such an open structure explains the great heat conductivity. Keesom and Taconis[12] have also taken X-ray pictures of solid helium, and suggest an hexagonal close-packed structure. In connection with the structure of liquid helium II Keesom and Taconis[11] discuss the diamond lattice hypothesis of London[13] and Fröhlich[14] and find that this hypothesis is not in harmony with their X-ray data.

It appears that the λ point may be explained in the same way as thixotropy by assuming that during the transition some helium molecules become locked in place in their equilibrium positions in a loose-packed structure, whereas the holes may change their places; the position and arrangement of the molecules change during the transition, but the electronic configuration of the molecules remains appreciably unaltered. This picture would lead us to expect that at the λ point, the viscosity, elasticity, thermal conductivity and specific heat are primarily affected, while the changes in the electrical and optical properties should be of the second order. It may be remarked that this picture is in agreement with the experimental observations carried out at the λ point.

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Methylation of Hydroxy-Flavonols

(Quercetin, Gossypetin and Herbacetin)

THE complete methylation of flavonols by the ordinary methods using dimethyl sulphate or methyl iodide is difficult since many of the substances undergo oxidation very readily in the presence of alkali. Diazomethane does not effect complete methylation in several cases. It has recently been shown by us[1,2] that methylation of all the free phenolic hydroxyl groups in glucosides of the flavonols can be indirectly brought about by treatment of the acetyl derivatives with dimethyl sulphate and alkali in acetone medium. We have now examined the suitability of this new method for methylating the flavonols themselves.

The methylation of quercetin through its acetyl derivative with dimethyl sulphate and alkali in methyl alcoholic solution was originally attempted by Cohn and Freudenberg[3] and as a result the completely methylated derivative, along with the partially methylated one (3:7:3′:4′-tetramethyl compound) was isolated. Acetone as solvent seems to possess a specific influence in promoting the methylation of the hydroxyl group in position 5. It has

now been found that *penta*-acetyl quercetin, when methylated with dimethyl sulphate and alkali as described already in one of our previous publications using acetone as solvent,[1] gives rise to the pentamethyl ether exclusively, and the yield is almost quantitative.

The hexamethyl ether of gossypetin was prepared by Perkin[4] through a laborious process by treating the flavonol with excess of methyl iodide and methyl alcoholic potash during two days. Besides the formation of other substances (probably partially methylated compounds) the nature of which Perkin could not characterise for want of sufficient material, the yield of the hexamethyl ether was not satisfactory. The action of diazomethane upon the flavonol does not produce the completely methylated ether, but a substance which melts at 166–68° and crystallises with five molecules of water. This substance is still under investigation. The hexamethyl ether can, however, be conveniently prepared by an application of the new method of methylation starting with the acetyl derivative. Hexamethyl gossypetin melting at 170–72° is obtained in very good yields.

We have recently shown that diazomethane does not completely methylate herbacetin,[5] and that the tetramethyl ether produced thereby (3:7:8:4′-tetramethyl herbacetin) undergoes further methylation with dimethyl sulphate and alkali in acetone medium to yield O-pentamethyl herbacetin melting at 156–58°. The pentamethyl ether has now been readily obtained by treating *penta*-acetyl herbacetin in acetone solution with dimethyl sulphate and alkali.

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Hysteresis in the Sorption of Water on Rice

The phenomenon of "Hysteresis in Adsorption" has attracted attention during the past few decades and has been interpreted from various points of view. Some of the systems investigated have charcoal,[1,2] gels of silica[3,4] and ferric oxide,[5] Gatton stone,[6] and platinum[7] as adsorbents. Organic natural colloids investigated, are comparatively few. Mainly cellulose[8] and its derivatives have been studied.

Physico-chemical investigations on rice by Sanjiva Rao[9] and co-workers have led to the view that rice is essentially a colloidal system intermediate between the lyogel and the xerogel. With a view to elucidate the nature of the phenomenon of hysteresis, sorption and desorption of water on rice were studied.

The technique adopted involved the use of the McBain-Bakr spring balance. Rice grains (the bran layer of which had been removed by polishing) were activated by dehydration at 65° C. vacuum. Successive sorptions and desorptions of water vapour were tried at 30° C. The results are indicated in Fig 1.

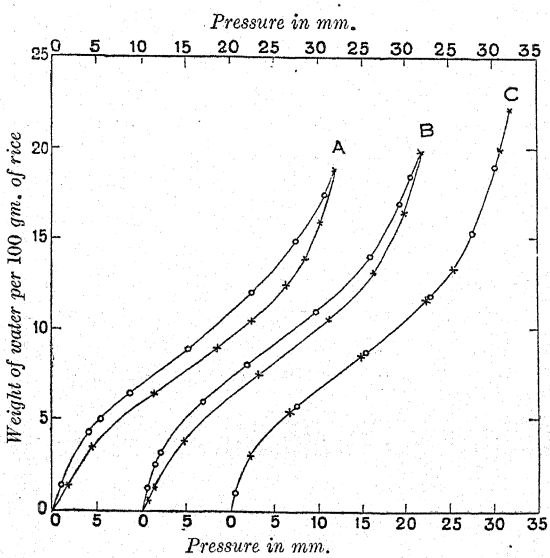

Fig. 1

Sorption and desorption of water on rice at 30° C.
A.—First sorption ×—×—× and desorption o—o—o
B.—Second ,, ,, ,, ,, ,,
C.—Third ,, ,, ,, ,, ,,

Rice gel behaves in a unique way unlike any other system yet studied in the fact that (*a*) when subjected to successive sorption and desorption, the hysteresis initially exhibited disappears, (*b*) the sorption capacity at the saturation pressure continuously increases.

McBain[10] has suggested that hysteresis is due to the filling up and emptying of cavities having narrow "necks". This explanation has hitherto been applied to hysteresis loops which are permanent and reproducible. The same concept can be employed to explain hysteresis and its subsequent disappearance in the case of rice. On its initial activation, rice has a rigid structure. Its capillaries have stable cavities and consequently rice exhibits hysteresis. When rice is subjected to successive sorption and desorption processes, the grain swells and the cavities now have elastic walls. With an increase in elasticity of the capillary walls, the cavities lose their power of trapping water. Thus at a certain stage (*i.e.*, in the third series of sorption and desorption) the hysteresis loop completely disappears. As a result of the loosening of the structure of the rice grain, consequent on progressive sorption and desorption, the capacity for water at the saturation pressure continuously increases. The fact that the hysteresis loop extends down to zero pressure indicates that some of the cavities have "necks" of molecular dimension.

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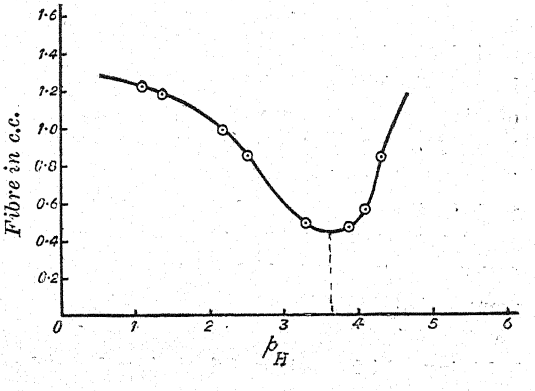
Adsorption of Ascorbic Acid by Lead Salts

In the course of our experiments on the isolation of ascorbic acid from *Phyllanthus embellica* (Indian gooseberry) it was found that lead acetate removes ascorbic acid, from an acid alcoholic extract of the dried powder of gooseberry pulp. The vitamin was found to be present in and removable from the precipitate. The fact that sulphuric acid was used for the acidification of alcohol, led to the suspicion that lead sulphate might be responsible for the adsorptive removal of ascorbic acid.

Experiments with an alcoholic solution of pure ascorbic acid (B.D.H.) acidified with sulphuric acid, showed that lead sulphate formed by the addition of lead acetate, removes ascorbic acid and it was further found that the quantity adsorbed depends upon pH. A study of the pH dependence on the removal of ascorbic acid by lead sulphate in the mixture was made, employing a standard alcoholic solution of ascorbic acid. pH of the reaction mixture was measured by the glass electrode and during all operations, an inert atmosphere was constantly maintained to prevent losses of ascorbic acid by atmospheric oxidation. The results are given in Table I and graphically represented in Fig. 1.

Table I.

pH	1·14	1·43	2·18	2·53	3·3	3·98	4·12	4·28
Tillman–Titre of filtrate after adsorption	1·21	1·2	1·0	0·86	0·50	0·48	0·67	0·84



It will be seen from the table and the graph that the optimum pH for the removal of ascorbic acid lies somewhere about 3·9. Further studies on the adsorption behaviour of other insoluble lead salts, are in progress.

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The Advance Monsoon in the West Coast

IN Travancore and Malabar there is usually a period of transition in May from the thunderstorm season of April to the south-west monsoon of June. Whereas the heat storms in April occur irregularly and the rain associated with them falls towards afternoon hours, *i.e.*, just after the period of maximum insolation, there occurs a change in May due to the advent of the monsoon winds resulting in more extensive thunderstorms and heavier rains not always confined to the afternoon hours. This condition may sometimes precede the burst of the regular monsoon by a few weeks or otherwise merge into it quickly without any break. Rarely does the actual monsoon current establish itself without such a transition period which is called the advance monsoon for that reason.

This year's advance monsoon conditions in Travancore area were remarkable for their suddenness and intensity, and also for the distinct break which has set in its wake. The monsoon conditions have yet to begin. But the period 5th to 10th May was one of unusually heavy rain in the coastal and submontane areas of Travancore, accompanied by severe lightning and thunder. Several stations gauged more than 7 inches of rain in 24 hours during this period, the maximum being 10·9 inches at Eraniel (a station in South Travancore) on the 10th May. The disturbed conditions of weather were noted in Trivandrum only after 11 p.m. on the 5th May. The incessant and severe lightning which continued in Trivandrum from about midnight till 1-30 a.m. on that night created general panic. This was accompanied by stormy winds and heavy rain, the wind reaching gale velocity (45–50 miles per hour) for about 5 minutes during the peak of the storm. Several big trees were uprooted and considerable damage caused to the telephone and town electric supply systems. The barograph at the Trivandrum Observatory recorded a rise of 0·07 inch pressure during the height of the storm and the hyetograph recorded 1·5 inches in about 15 minutes. This was evidently the result of the intrusion of moist monsoon winds into the drier tropical air and the consequent instability set up in the atmosphere. One could easily distinguish this type of thunderstorm from the afternoon heat storms of April. Whereas the latter storm would travel from the land area towards the sea, this travelled just the reverse way.

A feature of the advance monsoon of this year that appears noteworthy is that the monsoon current which produced the above instability of the atmosphere and such heavy rains in the coast and submontane areas for nearly 5 days was not strong enough to reach the Western Ghats. Not a single hill-station in the Devicolam High Ranges and other portions of the Ghats facing Travancore recorded any appreciable rainfall during this period. After the 10th May, perfectly clear and hot weather prevails till this day and the regular burst of the south-west monsoon is awaited.

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Microscopic Characters of Some Manganese Minerals, found in the Lateritic Manganese-Ore of Belgaum District, S.W. India

THE manganese ore occurs in the high-level laterite in the Belgaum District. The Dharwar gneiss and schists of Archæan age have been decomposed by weathering, giving rise to

lateritic rocks *in situ*. The manganese ore which is found to be associated with the laterite has been formed by metasomatic process.

On examining the ore by means of an ore-microscope, I have found two minerals—hollandite and romanéchite, which are not yet known to occur in the secondary manganese deposits of India. They are found to be formed side by side with psilomelane and polianite which are the two essential mineral constituents of the ore. I have determined the reflecting power of these minerals by the method of Prof. J. Orcel[1] with different photo-electric cells, sensitive to different wave-lengths.

Psilomelane is the principal constituent of the ore, it is isotropic, the reflecting power of this mineral has been found to be 0·263, for λ 6500Å, using a photoelectric cell of "couche d'arret" type with filter (Wratten No. 29F).

The etch test gave the following results. HCl 1:1 dilute—very rapid attack, H_2SO_4 conc.—blackening of the surface. H_2O_2 100 vol. —violent attack with effervescence.

Polianite occurs in spherolitic form. Fine aggregates associated with certain granular constituents are developed inside the spherolites. It is very strongly anisotropic. The R.P. has been determined by a similar procedure using different filters (Wratten No. 29F, and No. 90) and also by a gas-filled potassium cell sensitive to blue. The standard mineral taken is silicium 99%, whose R.P. is very close to that of these manganese minerals. The following results were obtained:—

Wavelength	R'_g	R'_p	$(R'_g - R'_p)$
4600 Å ..	0·432	0·374	0·058
5700 Å ..	0·385	0·359	0·026
6500 Å ..	0·383	0·348	0·035

The result shows that the R.P. of the mineral varies with the wave-length of light, the higher R.P. being more dispersed. The mineral has got normal dispersion. The results of the etch tests are:—

Positive: HCl 1:1 dilute—after five minutes, blackening of the surface (Diff. between polianite and psilomelane)
HCl conc., H_2SO_4 conc.,
H_2O_2 100 vol., $FeCl_3$ 20%, $SnCl_2$.

Negative: KCN, KOH, $HgCl_2$, and aqua regia.

Romanéchite.—Very fine needles of this mineral are found to be formed in the veinules produced in psilomelane. The R.P. determined by the same cell for λ 6500Å is

$$R'_g = 0{\cdot}290 \quad R'_p = 0{\cdot}261.$$

The results of etch tests are:—

Negative: HCl dilute 1: 1, HCl conc., $FeCl_2$ 20%, H_2O_2 100 vol.

Positive: $SnCl_2$ saturated, H_2SO_4 conc., H_2SO_4 + H_2O_2.

Hollandite is found to be crystallized side by side with romanéchite. It occurs in grains often associated with polianite, and psilomelane. Its R.P. is inferior to that of polianite. Using the same method the reflecting power has been found to be:—

$$R'_g = 0{\cdot}329, \quad R'_p = 0{\cdot}305.$$

The results of the etch tests are:—

Negative: HCl 1:1, HCl conc., HNO_3, KOH, KCN, $FeCl_3$ 20%.

Positive: H_2SO_4 conc., (slight attack), $SnCl_2$ saturated, H_2O_2 100 vol., H_2SO_4 + H_2O_2.

It is quite possible that these two minerals—romanéchite and hollandite—have been formed out of psilomelane, some of which has been dissolved and enriched afterwards by the addition of iron and barium. An excess of iron leads to the crystallization of hollandite, while its deficiency is responsible for the formation of romanéchite. Hollandite is a mineral which is known to be formed in the meso-zone of metamorphism; the microscopic study of this ore shows that it can also occur in the superficial sedimentary zone, in the lateritic rocks. It is evident from this study that romanéchite and hollandite are two distinctly different species. The reflecting power of hollandite is much greater than that of romanéchite. This fact can be further substantiated by the chemical composition, the etch test, and the

structural characters which are different in these two minerals.

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Lethality of Gametes Conditioned by Exchange of Segments between Partially Homologous Chromosomes in a *Nicotiana* Species Hybrid

IN studying the percentage of viable pollen in the species hybrid *N. glauca* × *N. Langsdorffii*, I found that their percentage corresponds approximately to the percentage of dyad and monad microspores formed in the hybrid as a result of non-occurrence of the first or of both meiotic divisions.[1] Studying the viability of the pollen in the species hybrid *Nicotiana Raimondii* ($n = 12$) × *N. tabacum* var. *Tyk-kulak* ($n = 24$) in connection with the dyad formation and the chromosome conjucation during the meiosis, quite different results were obtained. This hybrid, growing in the green-house, usually formed at the end of April (1939) 3–6 bivalents. Pollen-mother cells with 2 bivalents and with more than 6 were rarely found (ca. 6%). At the same time, in about 12–15% of the PMC dyad microspores were found. They usually resulted from non-occurrence of the first meiotic division (*i.e.*, restitution nuclei). When the flowers opened and the anthers dehisced no viable pollen were found. This indicates that both kinds of pollen grains: (1) those having reduced nuclei, as well as (2) those having non-reduced nuclei (dyads) with the total chromatine material from *N. Raimondii* and *N. tabacum* (36 chromosomes), were lethal. The lethality of the first kind of pollen originating from reduced microspores has been usually interpreted in assuming irregular distribution of the hereditary material during the meiosis and formation of tetrad microspore nuclei with incomplete and unbalanced genoms. The pollen originating from dyad microspores have two complete genoms, the whole *Raimondii* genom and the whole *tabacum* genom, nevertheless they were lethal. Non-viability of these pollen-grains is not due to loss of some chromosome fragments as a result of crossing over in inverted region or regions, because one chromatine bridge was very rarely observed (in 0·3% of the pollen-mother cells), during the meiosis. The most probable cause for their lethality is the exchange of segments between partially homologous chromosomes which takes place in each pollen-mother cell between 3–6 partially homologous chromosome pairs (bivalents) following chiasma formation. The reliability of this assumption is supported by the behaviour of the same hybrid plants during the autumn (1938) when their meiosis proceeded at a lower temperature. At this condition the hybrid usually formed 0–4 bivalents, and had in about 18% of the pollen-mother cells (PMC) dyad microspores; ca. 5% of the PMC having asyndesis (no bivalents). They formed then about 0·4% viable pollen grains. These pollen grains probably developed from PMC with asyndesis, in which the first meiosis has failed, thus producing dyad microspores and further pollen with whole chromosome sets and unchanged chromosomes of the parental species *N. Raimondii* and *N. tabacum*. It should be mentioned here that these two species are not closely related. They belong to two different sections —the former to *Rustica* section and the latter to *Tabacum* section.

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[1] Kostoff, D., *Journ. Genetics*, 1938, **37**, 120–209.

A Note on the Embryo-Sac and Endosperm-Haustoria in Some Members of Scrophularineæ

A FEW contributions were made by the author dealing with the development of endosperm haustoria in *Sopubia delphinifolia*,[4] *Alonsoa* sp.,[4] *Isoplexis canariensis*[5] and *Celsia coromandeliana*,[5] *Limnophila heterophylla*[6] and *Stemodia viscosa*.[6] The author has described several interesting structural variations in the haustorial cells in the above members. The structure of the embryo-sac and the development of endosperm haustoria in *Vandellia hirsuta*, Ham., *V. scabra*, Benth., *Rhamphicarpa longiflora*, Benth., *Centranthera hispida*, Br., and *Sopubia trifida*, Ham., have also been studied in all aspects, and papers dealing with the same will be published elsewhere. A brief account of some of the members is given below.

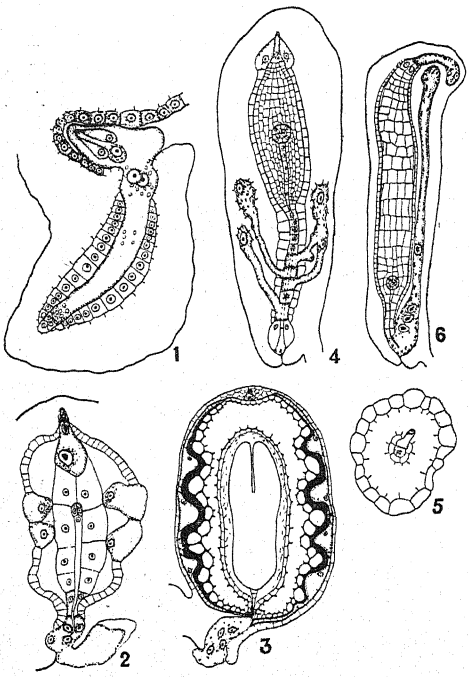
The presence of a reduced nucellus and a thick integument seems to be a constant feature. The eight nucleate intra-ovular embryo-sac is usually dilated towards the micropyle, and the egg apparatus is present in this part. *Vandellia hirsuta* (Fig. 1) forms an exception to this. Here the highly enlarged extra-micropylar part of the embryo-sac will be pressing against the placental and funicular epidermis from which nutrition is directly absorbed. A similar development of the sac is reported by Kausik[3] in *Utricularia cœrulea* and by Junell[2] in *Avicennia* and other members. The two polar nuclei are present in the middle of the sac, and the lower part is tubular and tapering towards the chalaza including three small antipodals. *Stemodia viscosa* is rather peculiar in having the chalazal part of the sac enlarged and the micropylar part tapering. Large antipodals and innumerable starch grains are present in this enlarged part, suggesting that this end probably takes part in the absorption of nutritive material from the integument before the chalazal haustorium is actually laid down. In all these plants the integumentary tapetum surrounds the non-dilated part of the sac and shows varying degrees of development.

In most cases observed till now the polar nuclei fuse to form the secondary nucleus just before fertilization. The several stages in fertilization studied by the author suggest that this process is of a normal type. The two species of *Vandellia* are interesting inasmuch as the antipodals persist long after the fertilization.

Just as in the previous forms there is the first division of the primary endosperm nucleus followed by the formation of a transverse wall dividing the embryo-sac into the chalazal and micropylar chambers of varying sizes. The second transverse division of the sac often takes place in the micropylar chamber. Thus by two transverse divisions the embryo-sac is divided into the chalazal and micropylar chambers with a cell between them. The last one by a series of divisions becomes endosperm tissue and accumulates plenty of starch, while the two chambers by further development become the chalazal and micropylar haustoria.

The chalazal chamber in *Limnophila*[6] and *Stemodia*[6] remains undivided and develops directly into a large and highly aggressive uninucleate haustorium. Generally there is a longitudinal division of this chamber and two uninucleate haustorial cells are organised. In the two species of *Vandellia* (Fig. 2) and in *Rhamphicarpa* (Fig. 6) a single binucleate haustorium results by the early fusion of these two uninucleate cells. The haustorium in *Vandellia* (Fig. 2) shows a decided tendency to become a uninucleate body, often by the degeneration of one of its nuclei and at times by the absence of a nuclear division. The chalazal haustorium in *Centranthera* (Fig. 5) is reduced in size and seems to be an almost nonfunctional body, while in *Rhamphicarpa*, *Limnophila* and *Stemodia* this happens to be highly enlarged and aggressive in nature. The mature chalazal haustorium in *Vandellia* shows cellulose rods whose disappearance during the haustorial degeneration forms a very interesting feature. Although Schmid[8] attributes a mechanical role to these rods, their disappearance in *Vandellia* is more in favour of the idea of a nutritional rôle. The older haustoria are

characterised by the presence of hypertrophied amœboid nuclei and darkly stained cell-contents.



1. *Vandellia hirsuta.*—Longitudinal section of the ovule showing the extra-ovular embryo-sac, tapetum and other parts of the ovule. × 240.
2. *Vandellia hirsuta.*—The two kinds of haustoria, tapetum and endosperm. × 13.25.
3. *Vandellia hirsuta.*—Longitudinal section of a nearly mature seed showing the haustoria, endosperm embryo and the peculiar tapetum. × 58·75.
4. *Centranthera hispida.*—Development of the endosperm and the formation of the haustoria. × 80.
5. *Centranthera hispida.*—Transverse section of the ovule showing the formation of the secondary endosperm haustoria. × 80.
6. *Rhamphicarpa longiflora.*—Formation of the endosperm and the two kinds of haustoria. × 48.75.

Often two longitudinal divisions take place in the micropylar chamber although in some members like *Centranthera* and *Gratiola officinalis*[1] only one may be present. At times even the single divisional wall may be incomplete as is reported in *Paulownia tomentosa.*[7] Thus the two longitudinal divisions result in the formation of four uninucleate haustorial cells which fuse at a later stage to form a tetranucleate body (Figs. 2 and 6). In *Vandellia hirsuta* and *V. scabra* this does not enlarge much. In *Rhamphicarpa* (Fig. 6) this tetranucleate body forms a branching aggressive haustorium with the hypertrophied nuclei placed in the tube-like branches which eat their way into the integument and approach the chalazal haustorial tube. At times the two haustoria communicate with each other by the disorganisation of the intervening tissue. *Centranthera* (Figs. 4 and 5) seems to be remarkable in showing the formation of secondary haustoria since the first formed micropylar haustorial cells also appear to be almost nonfunctional. In this plant some of the endospermal tiers connecting the micropylar haustorium with the deeply placed endosperm tissue send out haustorial tubes into the integument and absorb nutrition by disorganising its cells (Fig. 5). Thus the delay in the organisation of endosperm proper in *Centranthera* may be attributed to the peculiarity in the haustorial formation.

The haustoria in *Vandellia* and *Centranthera* seem to be inadequate to meet the nutritional demands of the growing endosperm and embryo. In these members the tapetum comes in very handy. Some of the cells of the persistent tapetum enlarge in a significant manner (Figs. 2–4) and take part not only in the digestion and absorption of the tissue contents of the integument but also in the storage of the same and their transportation to the developing endosperm later on. The distribution of these cells along the tapetal sheath appears to be irregular in the two species of *Vandellia,* while in *Centranthera* these are confined to the chalazal end of the sheath. Just as in *Celsia* the tapetum in *Vandellia* shows its inner wall highly thickened, which forms thus a probable device for the protective rôle.

I wish to thank Dr. M. A. Sampathkumaran, M.A., PH.D., Professor of Botany, Central

College, Bangalore, who was kind enough to give me all facilities for this work.

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May 4, 1939.

[1] Glisic, Lj., *Bull. Inst. Jard. Bot. Univ.*, Beograd, 1933, Tom **2**, No. 3, 129–52.

[2] Junell, S., *Symb. Bot. Upps.*, 1934, **4**, 140–46.

[3] Kausik, S. B., *Beih. Bot. Centralbl.*, 1938, **58**, 365–78.

[4] Krishna Iyengar, C. V., *Journ. Ind. Bot. Soc.*, 1937, **16**, 99–109.

[5] ———, *ibid.*, 1939, **18**, 13–20.

[6] ———, Unpublished.

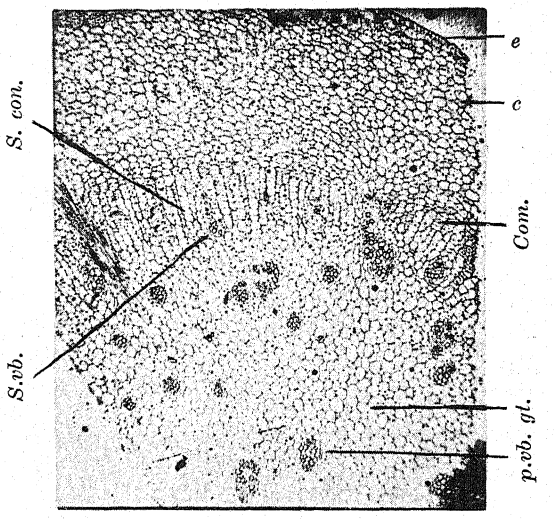
[7] Millsaps, V., *Journ. Elisha. Mitchell Sci. Soc.*, 1935 **52**, 56–75.

[8] Schmid, E., *Beih. Bot. Centralbl.*, 1906, **20A**, 175–299.

Secondary Growth in the Bulb of *Polyanthes tuberosa* L.

Polyanthes tuberosa L. (Amaryllidaceæ, according to Engler and Hutchinson), a native of Central America, Trinidad, is now fairly common as a garden plant in India. The bulb of this plant shows secondary growth like that found in the aerial stems of *Dracœna*. Both the primary and the secondary vascular bundles are collateral in the bulb of *Polyanthes*, while they are concentric in the aerial stems of *Dracœna*. Pfeiffer[2] in 1926 recorded that the underground stem of *Polyanthes tuberosa* is homologous with the aerial stem of *Dracœna* in the matter of secondary growth. In such monocotyledonous stems with sufficient secondary growth, it becomes somewhat difficult to distinguish the secondary tissues from the primary ones. But this difficulty can be easily overcome by the following diagnostic characters of Röseller as cited by Cheadle[1]:—(1) the paucity of phlœm elements in the secondary bundles, (2) the oval shape of the secondary bundles, (3) the more or less radial placement of these bundles, and (4) the radial orientation of the conjunctive tissue. In addition, Cheadle[1] holds that the short sieve-tubes and the lack of spiral or annular elements in the secondary bundles are valuable criteria.

Small pieces of young bulb of *Polyanthes tuberosa* L. were fixed in "Craf" overnight, according to Randolph[3] and directly taken to 75% alcohol, and after changing three or four times the usual processes of dehydration and infiltration were followed. Serial microtome sections 6 to 10 μ thick were cut transversely from the growing point of the stem to its base and the sections of the younger part were stained in Delafield's hæmatoxylin only, while those from the older parts were stained in safranin and Delafield's hæmatoxylin. On examining sections from the tip, protected by crowded leaves with axillary rudimentary buds, young primary vascular bundles were found scattered in the ground tissue a little lower down. When the sections of comparatively older part away from the tip are examined, the primary growth is found to be complete and very soon secondary elements begin to develop from a distinct ring of cambium (Fig. 1). On cutting sections 10 to 15 μ thick from older



e.–epidermis; *c.*–cortex; *cam.*–cambium ring; *s.vb.*—young secondary vascular bundle; *s.con.*–secondary conjunctive tissue separating the secondary vascular bundles; *gt.*–central ground tissue with scattered primary vascular bundles (p.vb.); *p.vb.*–primary vascular bundle. (Photomicrograph—Eyepiece 15 × and Obj. 40 mm. apochromat.)

bulbs by freezing microtome and staining them in safranin and Delafield's hæmatoxylin the secondary vascular bundles in all stages of development are found prominently separated from each other laterally by the radially elongated secondary conjunctive tissue; these sections show clear secondary growth with superficial periderm and cork cambium, though in the younger bulb (Fig. 1), the periderm and the cork cambium are both absent. In *Dracœna* stem Strasburger[4] (Fig. 44) also clearly demarcated the secondary conjunctive tissues with radially elongated cells from the rest of the central polygonal cells of the primary ground tissue.

Secondary growth in Monocot. stem with the help of permanent cambium has been observed in stems of local *Curculigo recurvata* (Amaryllidaceæ) and *Sansevieria zeylanica* (Hæmodoraceæ) as recorded by Pfeiffer[2] and Cheadle.[1] Thus, the total number of Monocot. plants, so far investigated, which show secondary growth by permanent cambium, belongs to about 19 genera, *viz., Aloe, Cordyline, Dasylirion, Dracœna, Kniphofia, Nolina, Yucca, Xanthorrhœa* and *Veratrum* (Liliaceæ), *Agave, Furcrœax, Polyanthes* and *Curculigo* (Amaryllidaceæ); *Aristea* and related genera (Iridaceæ); *Testudinaria, Tamus* and *Dioscorea* (Dioscoreaceæ); *Sansevieria* (Hæmodoraceæ); and *Acorus calamus* (Araceæ).

Polyanthes tuberosa L., being a very common garden plant in India, the attention of Indian botanists is drawn to its anatomy.

I am greatly indebted to Dr. S. R. Bose, Professor of Botany of this College, for his valuable help and criticism in this work.

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May 3, 1939.

[1] Cheadle, Vernon, I., "*Bot. Gaz.*, 1937, **98**, 535–55.
[2] Pfeiffer, H., *Handbuch der Pflanzenanatomie. K. Linsbauer*, **Band IX**; *Das Abnorme Dickenwachstum*, Bremen, 1926.
[3] Randolph, L. F., *Stain Tech.*, 1935, **10**, 95.
[4] Strasburger, E., *Handbook of Practical Botany*, 1924, 8th Edition, Fig. 44, p. 118.

Loss of Water by Evaporation from the Upper Surfaces of Soil Columns Resting on a Water Table

It is well known that, if a layer of soil rests above a water table, moisture ascends upwards in the soil; the height up to which the moisture ascends as well as the rate of ascent depend upon the physical properties of the soil. The fact that the actual rise of moisture is much smaller than what one should expect according to the classical "capillary theory" has been pointed out by several writers.[1]

If the top of the soil column is freely exposed to the atmosphere, evaporation of moisture takes place, the evaporation depending partly upon the saturation deficit and velocity of the air layers immediately above the soil and partly upon the rate of arrival of moisture at the soil surface from the lower layers.

To conduct preliminary experiments on some of the above phenomena with typical Indian soils, a soil evaporimeter with bottom feed was constructed locally. This consists of a metallic cylinder 5" in diameter containing soil and is kept with its perforated bottom in contact with water in a close fitting reservoir. Fig. 1

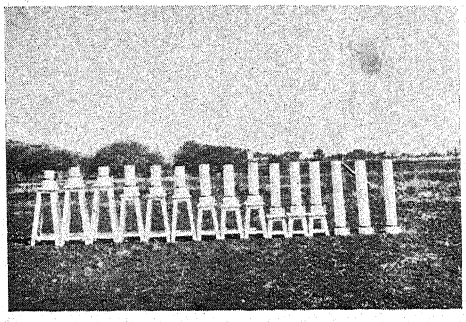

Fig. 1

shows a series of these evaporimeters in triplicate with soil columns 6", 1 ft., 1½ ft., 2 ft. and 3 ft. respectively in depth. The three instruments corresponding to each of the depths mentioned above, were filled with Poona soil (black-cotton), normal Punjab soil (alluvial) and "bari" (alkali) soil from the Punjab respectively. The packing of soil into the vertical cylinders was done uniformly. The evaporimeters were weighed daily at 8 a.m., replenished with water upto a reference mark on a side

tube of glass, and then weighed again. The difference between the weight after adding water of one day and the weight before adding water of the next day gives the actual loss of water by evaporation from the upper surface of the soil column. To ensure uniformity of exposure the series of soil evaporimeters was set up on suitable wooden platforms so that the tops of all the instruments were at the same level above ground.

The time taken by water to rise upto the top of the different soil columns in the different soils (this is indicated by the appearance of wetness at the surface and also verified from the daily evaporation losses) is given in Table I below.

Punjab soils the wetting of the soil at the surface does occur even when the subsoil water level is 3 ft. In "Bari" soil from the Punjab, however, water is unable to ascend beyond 6 inches even after the lapse of several months.

The actual loss of moisture may now be considered. The experiments with five different depths of each of the three soil types were started on the 5th December 1938. The data for the month of December need not be considered as it takes some time for a steady state to be attained. The mean daily evaporation in inches, during January, February and March 1939, as well as the mean daily evaporation in inches from a Piche evaporimeter kept at 4 ft. above ground are given in Table II.

TABLE I

Type of soil	Height of soil column				
	6 in.	1 ft.	1½ ft.	2 ft.	3 ft.
Poona soil	1 day	2 days	6 days	15 days	Not wet even after 3 months
Punjab soil (normal) ..	1½ days	3 ,,	5 ,,	10 ,,	21 days
" Bari " (alkali) soil from the Punjab	3 ,,	Not wet even after three months			

TABLE II

Month	Type of soil	Mean daily evaporation in inches from the top of soil columns with depths of					Piche evaporimeter 4 ft. above ground
		6 in.	1 ft.	1½ ft.	2 ft.	3 ft.	
January 1939	Poona soil	·30	·27	·18	·12	·01	·45
	" Bari " soil from Punjab ..	·05	·02	·02	·01	·01	
	Punjab soil (normal)	·29	·23	·21	·18	·09	
February 1939	Poona soil	·38	·34	·22	·15	·02	·56
	" Bari " soil from Punjab ..	·06	·02	·02	·02	·01	
	Punjab soil (normal)	·37	·26	·22	·18	·09	
March 1939	Poona soil	·48	·41	·23	·16	·02	·71
	" Bari " soil from Punjab ..	·05	·03	·03	·02	·01	
	Punjab soil (normal)	·43	·30	·21	·17	·08	

It is thus seen that in the case of Poona soil actual wetting at the soil surface does not take place even after the lapse of three months when the subsoil water level is more than 2 ft. below the surface. In the case of the normal

From Table II the following general conclusions may be drawn:—

(1)) The amount of water lost by evaporation decreases as the water table recedes below the surface; when the water table is 3 ft. below

the surface the loss of water is considerably smaller than when the water table is only 6" below the surface.

(2) Comparing the three soil types amongst themselves it is seen that the loss of water from "Bari" soil (alkali soil containing a large percentage of salts) is strikingly smaller than that from either the normal Punjab soil or the Poona soil for all the depths of the water table considered in these experiments.

(3) Comparing the alluvial soil from the Punjab and the black cotton soil of Poona it seems that the amount of water lost from both of these soils is of the same order of magnitude, with this difference, however, that when the depth of the water table is greater than 1½ ft., evaporation from the alluvial soil of Punjab (which is more porous) is somewhat more than from the black cotton soil of Poona (which has a larger clay-fraction and is less porous).

The experimental results will be discussed at greater length in a later publication.

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A. K. MALLIK.

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May 9, 1939.

[1] Keen, B. A., "The Physical Properties of the Soil," *The Rothamsted Monographs on Agricultural Science*, Chapter III, 1931.

Studies on the British *Aleurodidae*

THE British species of *Aleurodidae* have not received the due share at the hands of the entomologists in the past. Their comparative morphology and bionomics were not thoroughly studied and unfortunately their systematics were also left in the same unsatisfactory state. Even until recently the position of some of the British species was as undefined as before, since their descriptions could not afford positive diagnostic characters.

The original specific differentiations of the species under reference were based primarily on their food plants and such variable characters as the colour and shape of the body, the number of hairs on pupæ, or the relative proportion of the antennal segments. The subsequent workers, in most cases, reconciled with the original views without even doubting the possibility of variations in such characters or realising the significance of biological necessity for the extension of alternative food plants and their consequent influence on any of these characters.

The present investigations, therefore, were taken up at the Rothamsted Experimental Station, with the object of studying the available species, with regard to their systematics, food plants and habits, etc.

Since the differentiating features of the nature stated above were found to be of least specific value for classification purposes, attempts were made to establish more reliable differences on the basis of certain constant characters. As the vasiform orifice is quite specific to this family and is a constant organ in all the stages after the egg, and the gentilia has also yielded results of considerable interest in the taxonomy of other insects and is often used in determining species and genera, therefore, a thorough comparative study was made of both these characters along with others, and specific differences of significance were noted.

Of the nineteen species recorded in Britain, fifteen were studied during these investigations. Besides, two new species, namely, *Aleuroplatus kewensis* and *Trialeurodes williamsi* were described[1] from ferns in hot houses at Kew Gardens.

Four pairs of the species previously considered as different, namely, (1) *A. carpini* and *A. rubicola*, (2) *A. lonicerœ* and *A. rubi*, (3) *A. proletella* and *A. brassicœ*, (4) *A. quercus* and *A. avellanœ*, have now been shown morphologically identical in all their stages, which are also described. Their identity has also been established by cross inoculations, as well as, by life-history studies. Moreover, a new genus *Asterobemisia* is proposed for the species in Set (1) and that under (4) is shifted to genus *Pealius* according to the characters of the pupa, and a new description is given for the adult of *P. quercus*,[2] because the previous one did not agree with this species.

Further, some significant differences are also shown for *S. phillyreœ* and *S. immaculata*, and certain differential characters have been pointed out for *T. sonchi* and *T. vaporariorum*. The immature and adult stages of *S. phillyreœ* are also described and some stages of *T. ericœ* and *D. chittendeni* are described for the first time.

Seasonal colour variations were also studied in the pupæ and adults of *A. lonicerœ*, both in nature as well as in the laboratory, and at the same time some new alternative food plants were recorded in several species. It is therefore suggested that, such variable characters may not be regarded as conclusive when following any work of systematic nature in *Aleurodidœ*.

Parasites and parasitism were also studied in some species of British white-flies. Transfers of parasites from one species to the other, proved successful when those from *S. phillyreœ* and *T. vaporariorum* were bred on *A. proletella*.

Relative oviposition and the rate of development under coloured screens was studied in *A. proletella* and *T. vaporariorum* under laboratory conditions.

The results of all the above investigations are being compiled and will be published very shortly.

The assistance of Dr. C. B. Williams and the encouragement by the Indian Central Cotton Committee, by the grant of a foreign scholarship, are gratefully acknowledged.

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Lyallpur,
February 2, 1939.

[1] Trehan, K. N., *Proc. R. Ent. Soc. Lond.*, (B), 1938, **7**, 182.

[2] The genus proposed by the present author.

With the Compliments of "Current Science"

SIR RICHARD GREGORY, Bt., D.Sc., F.R.S., LL.D., F.R.Met.Soc., F.Inst.P.

REVIEWS

The Properties of Glass. By George W. Morey. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1938. Pp. 561. Price $12·50.

Whoever has read Morey's recently published book, must have come to the conclusion that the international literature on glass has gained a work of fundamental importance. It fills a gap, as no book on glass physics, of this class, was available in English.

The Germans have the *Glastechnische Tabellen*; as the name indicates, it is meant more for reference than for continuous reading. In French appeared in the last few years, Long's excellent book and Damour's three volumes, dealing with physical properties of glass. Both go out from industrial and manufacturing problems, devoting much space to description of processes, the understanding of which is the main aim of the authors.

Morey's book is based on the conception of pure glass science, it avoids any discussion or description of technicalities of industrial glass making. It deals with the physics of glass only, and is in its kind the most exhaustive and complete work that has ever appeared on the bookshelves.

The author's thoroughness, his indisputable talent for clear arrangement of dry data and facts in a pleasant and readable way, his logical penetration into the respective merits of diverging theories, further his personal authority, allowing a general welding together of other people's work with his own research and experience, qualify the book not only as a mine of information, but also as an instrument for better understanding of intricate phenomena. It is the first attempt on a general synthesis of the science of glass and a successful one.

All chapters are equally good and in line with the character of the work. The definition of glass, its composition, devitrification, durability, viscosity, annealing, tension, heat capacity, density, expansion, thermal endurance, etc., etc., are their respective subjects. The critical and conversant reader will hardly find anything of importance omitted.

Technicians and industrialists will find the chapters most instructive and informative, the scientist will gain by the masterly co-ordination of knowledge; all will appreciate the art of accurate thinking.

Morey's *Properties of Glass* is a standard work and its appearance, a paramount literary event in the glass world since Dralle's first edition in the pre-War days.

A. NADEL.

Reports on Progress in Physics. Vol. V. (Published by the Physical Society, London), 1939. Pp. 445. Price 20*sh.*

This is the fifth of the series of reports on the Progress in Physics published by the Physical Society of London, under the editorship of Prof. Alan Ferguson. The aim of these reports according to the editor is "to present articles which shall discuss the latest developments in physical science, and which shall at once make clear to the non-specialists the meaning and extent of these advances, and provide the researcher in the particular field under discussion with a technical resumé helpful to him in his own work". The articles appearing in these reports are not so specialised or detailed as those appearing in the *Review of Modern Physics* or in the *Ergebnisse der Naturwissenschaften.* But within the prescribed limits, they are well written and very timely. The retiring editor of these reports Prof. Ferguson is to be congratulated on the success with which he has carried out his aim in the present volume.

The articles contained in the present issue are (*i*) reports on recent advances in different branches of Physics, and (*ii*) special articles on certain aspects of theoretical and experimental physics and on technical applications of physics, which have come into prominence recently. It is not possible for the writer to review adequately all the

articles which appear in this Report. Mention is made below of some of the articles which have been of interest to him.

Mott and Gurney give a useful summary of certain theories of the liquid state which are based upon the assumption that a liquid is a broken up or disordered solid. The report on the soft X-ray spectroscopy of the solid state by H. W. B. Skinner is of great interest, as such investigation enables the electron level characteristic of a given solid to be determined. The article by W. V. Mayneord 'On the use of X-rays and γ-rays in medicine' is very timely in view of the rapid advance in the technique of high voltage generation and its application to the production of penetrating X-rays.

Users of Geiger counter tubes will find an article on the subject by A. Nunn May very helpful. The article by F. C. Champion "On the single scattering by elementary particles", specially by neutrons and protons is of interest in view of the information they give about nuclear binding forces. Some recent developments in Quantum Mechanics and the difficulties associated with the first order equation of Dirac are reviewed by H. T. Flint.

Of special interest to students of Cosmic rays is a very well-written report on the subject by W. Heitler, who has himself contributed largely to our understanding of the effects produced by the soft components of the Cosmic radiation. The reviewer has found it to be a very good introduction to a rather difficult and complex branch of investigation.

Among articles reviewing recent technical applications of Physics mention may be made of the following: 'Plastics in industrial physics' by H. W. Melville, 'Instrumental aids for defective hearing' by Phyllis Kerridge, 'Television optics' by W. D. Wright and 'Electric wave filters' by N. F. Astbury.

During the last few years there has been a rapid advance in the teaching of science in schools and intermediate colleges in this country. Those who are responsible for the introduction of such courses and also for physics teaching will be specially interested in the last article in this volume 'On the teaching of physics in schools' by A. W. Barton. The reviewer has read the article with great interest and profit.

D. M. Bose.

American Medicine (Expert Testimony Out of Court). Vols. I & II. (The American Foundation, 565, Fifth Avenue, New York), 1937. Pp. 1,435.

These two sumptuous volumes forming the study of the American Foundation, are devoted to the consideration whether government should or should not play an increasing part in the administration of public activities in the organization of medical care. The Medical Advisory Committee associated with the Foundation Studies issued a comprehensive questionnaire to their colleagues, and the replies received constitute the text of the two volumes. There is no department of medical enquiry which has not been adequately covered by the replies, and there must be general agreement about the usefulness of making the report available for the professional men and the public. It would not be correct to describe the books as a compilation of opinions, valuable as they are, but they hold within their compass many useful and significant facts, not of the usual statistical importance, but of the kind derived from realized experience. The whole object of the two volumes is to illuminate the several issues involved in the questionnaire, and not to prove any pet doctrine; and the replies therefore deal with problems capable of being handled experimentally by all the resources of science and statesmanship. The letters on which the volumes are based are about 5,000 from approximately 2,100 medical men. This stupendous mass of correspondence is, however, so analytically arranged under suitable heads, that the reader can easily find collected under his favourite topic a wide body of intelligent information. At first sight the two volumes might seem formidable even to a voracious appetite, but once the reader plunges into the study, the interest he develops will carry him safely through the 1,290 pages, the matter provided being calculated to stimulate rather than to cloy his keenness.

A store of information of such magnitude and importance cannot fail to invoke the interest of the professional medical men and practical statesmen charged with the duty of organising the welfare and medical care of the public. This work of reference has a permanent value. We hope that it will be widely welcomed and appreciated.

Medical Entomology (A survey of Insects and Allied Forms which affect the Health of Man and Animals). By William A. Riley and Oskar A. Johannsen. Second Edition. (McGraw-Hill Publishing Co., Ltd., London), 1938. Pp. xiii + 438, Price 25/-.

The second edition of this book which has incorporated all the latest advances obtained from the laboratory investigations and field researches, provides a complete and competent knowledge of one of the important departments of medical science. Insects and parasitic arachnids, having victimised the precursors of man, have been tormenting him since his appearance on this planet, and the war against them, with all the resources which science has placed at his disposal, has not ended and probably may not end. This warfare is full of romantic episodes and human interest. Apart from the professional importance usually attached to a book on Medical Entomology, the interest it holds for the well-being and economic efficiency of the community should be sufficient inducement for the general public to become acquainted with the fundamental principles of this fascinating branch of science.

Students of medicine will find in this book a full and competent exposition of the subject of transmission of diseases by insects and other allied members, together with a complete account of the measures to control their dangerous increase menacing the spread of dire scourges. Municipal commissioners will discover a store of valuable information indispensable for dealing promptly and satisfactorily with the problems of public sanitation and general hygiene. Health Officers will welcome this book as a faithful companion in their efforts to control epidemics, and Ministers of Public Health fortified by an intimate knowledge of the latest developments in the science of medical entomology, would be able to formulate wise and far-reaching policies ensuring the health and diminishing the incidence of disease in the body politic.

This deeply interesting and stimulating book written with considerable insight and knowledge, should appeal to professional men and the ever-widening circle of intelligent readers who wish for an enlightened attitude to all that pertains to a healthy and prosperous human existence.

Any scientific work must necessarily include large sections on systematic and anatomical studies, but the chief merit of the treatment of these topics as presented by the authors is that instead of scaring away the general reader, it provides added interest to his understanding. The life-histories of insects are told in simple language and the numerous illustrations which are clear and attractive will enable the lay readers to obtain a vivid picture of the whole developmental process of the group. The chief importance of the subject of entomology lies in the fact how the insects which must have entered at first into symbiotic relations with the warm-blooded animals, gradually changed this phase of biological phenomenon into parasitic habits, with dreadful consequences to the hosts. Perhaps recruitment to the ranks of parasitism is silently taking place at present in order to restore the balance of power in their conflict with man who is their only implacable enemy. The fact that Nature, while destroying the gigantic lizards and mammals, has carefully preserved the flea, the louse, the bug and the cockroach, shows that the power to survive cataclysmic changes on the part of insects is infinitely greater and more varied than in the highly specialised creatures, and the laurels of the fight will necessarily go to the party more favourably endowed. At present man seems to be engaged in an unequal contest, but later on when his knowledge and resources become fuller he may deal a death-blow at the vermin pestering him, and before he does so, he must have a deeper understanding of the consequences resulting from the extinction of his enemies.

Those who wish for more information than is contained in the book are referred to an extensive Bibliography provided in the Appendix, and others who may wish to have a ready weapon to deal with the household pests have a chemical formula indicated, with directions fumigating them.

The book is a welcome contribution to the science of Medical Entomology. It is bound to be widely appreciated.

Electrical Engineering Practice. By J. W. Meares and R. E. Neale. Vol. I (5th Edition). (Chapman & Hall, Ltd., London), 1938. Pp. 780. Price 25*sh.*

The fifth edition of this very useful book will be equally welcome to the engineer and the student of modern electrical practice. It treats the subject simply but exhaustively and no important advance in equipment or

practice seems to have been omitted. In the present edition the book has been thoroughly revised and considerably enlarged by the addition of a lot of new up-to-date matter. It aims at filling a gap between pocket books containing technical data and technical works by specialists dealing with individual branches of electrical engineering, the book deals not only with a mass of useful technical data and information relating to modern methods but also with simple and clear explanations relating to electrical phenomena and theory. Yet throughout it is essentially practical in tone and contains information of a strictly utilitarian nature. It will thus be useful not only to the electrical engineer but also to the civil or mechanical engineer who has anything to do with electrical engineering. The Bibliography at the end of each chapter adds considerably to the value of the book and makes it a useful work of reference which should find a place in the library of every engineer. That it fills a real want can be seen from the fact that it has now run into the fifth edition.

F. N. M.

The Commissioning of Electrical Plant and Associated Problems. By R. C. H. Richardson. (Chapman & Hall, Ltd., London), 1939. Pp. 380, 201 figures. Price 21*sh.* net.

Many readers of this book will find the "associated problems" of more interest than the main subject of the title. It is divided into sections dealing with the main types of electrical plant: the first part of each section deals with the commissioning of the particular type and this is followed by chapters on troubles in that type, peration, and "theoretical and practical considerations relative to running".

The "Commissioning" part is a very complete and up-to-date collection of information, instructions and points to be taken care of, while the remainder of the book deals with a variety of interesting problems which is not usually found between the covers of one book and it is a valuable addition to the literature on electrical engineering. Power engineers will find the whole of the book of direct application to their work, while students will find in it a collection of problems which will be directly useful to their studies, such as neutral point earthing, parallel operation of transformers, calculation of short-circuit currents, measurement of power factor, etc. The last chapter contains useful "technical methods", for those whose mathematics is not too strong, on such matters as Symmetrical Components.

The whole book is well written in a concise manner, right up-to-date and includes many points not previously covered in text-books.

It is easy to read by anyone with even elementary ideas of electrical engineering and requires only a limited knowledge of mathematics.

K. ASTON.

Chemistry of Proteins. By Dorothy Jordan Lloyd and Agnes Shore. Second Edition. (J. A. Churchill, Ltd., London), 1938. Pp. xi + 532. Price 21*sh.*

Since 1926, when the first edition of this volume made its appearance spectacular advances have been made in the field of protein chemistry. The Carbobenzoxy method of Bergmann, which has revolutionised the synthesis of peptides, has led to the elucidation of the nature of proteoclastic action on the one hand and of protein structure on the other. Advances in immuno-chemistry and nutrition, crystallisation of proteoclastic enzymes and plant viruses, X-ray studies of proteinous fibres, ultracentrifugal studies of these high molecular compounds at Upsala, have all wielded a tremendous influence on the progress of protein chemistry and these represent studies which have been made since the publication of the first volume. A second edition of the volume has, therefore, not appeared a little too early, and has appeared as a collaborative effort. The incorporation of these developments has necessitated the omission of the industrial aspects of protein chemistry, which were featured in the first edition. We have no doubt that the authors will plan the publication of a companion volume devoted to a discussion of the applied aspects of the subject.

The task of weaving together the advances in such apparently diverse fields, from enzyme chemistry to X-ray analysis, has been admirably accomplished by the authors and we have in this volume a well-knit account of the chemistry of proteins clearly presented and critically appraised. This is a volume which should have wide appeal to a large circle of investigators, physicists, chemists, physiologists and biochemists all of whom will warmly welcome the appearance of a well-informed text-book on protein chemistry in the English language.

M. S.

The Origin of Life. By A. I. Oparin. (Messrs. Macmillan & Co., Ltd., London), 1938. Pp. 270. Price 8/6.

An extremely fascinating book which seeks to give a physico-chemical explanation for the origin of life. All theories in support of the spontaneous generation of life are briefly stated and dismissed as fantastic. The conditions on earth when it separated out from the Sun were such as to make existence of life impossible. It is logical to presume that the manifestation of life has taken place during the evolution of matter. Carbon, nitrogen and other elements present in the Sun passed into the gaseous matter which ultimately condensed to form the earth, and in the process of cooling down, produced carbides and nitrides of heavy metals. The interaction of these substances with the aqueous vapour present in the atmosphere, gave rise to hydrocarbons and ammonia and from these arose a variety of organic substances which became progressively complex through polymerizations and condensations. These complexes were held in colloidal suspension in the water of the seas. As the colloidal suspensions of different substances came together, new forms, the coazervates, resulted which got separated from the aqueous medium. The coazervates developed within themselves definite physico-chemical structures and their further history depended upon their ability to incorporate into themselves the organic substances present in the medium, or in other words, their ability to grow. A dynamic condition was thus established and only such coazervates survived which developed a favourable internal organization. The 'life' so begun started on its course of evolution.

The coazervate thus becomes the pattern of life and occupies the central position; in fact, it lies between the living and the non-living. At a later stage, it acquired such attributes as adaptation, movement, metabolism, reproduction, which are generally associated with life.

That the origin of life must be capable of explanation from pure physico-chemical considerations is an article of faith with the scientist. Just as the once insurmountable barrier between inorganic and organic matter vanished with the synthesis of urea by Wöhler, even so, the transformation of non-living matter to living substance capable of exhibiting directive and self-duplicating powers may become capable of rigorous proof. The question is, how far has such a proof been furnished? In his review on *The Laws of Heredity and the Cause of Evolution,* Dr. MacBride (*Science Progress,* 1939, 33, 773) refers to a reply which Sir James Jeans gave when he was "chided" for using the word "creation". The reply was "It is all very well, science takes you back a certain distance and then brings you up against a blank wall". We admit that Prof. Oparin has taken the wall to a greater distance than ever before but it is doubtful whether the wall has been demolished. The origin of organic matter, of colloids and of coazervates has received plausible explanation but while one is in full accord with Prof. Oparin in the possibility of Coazervates developing structures and even undergoing duplication, it would be pertinent to ask whether such capacity distinguishes the living from non-living matter? Traube's 'artificial cells' too have structures and exhibit the phenomena of growth and multiplication. To say that with the coazervates "a peculiar selective process had come into play which finally resulted in the origin of colloidal systems with a highly developed physico-chemical organization, namely, the simplest primary organism", is to import into the discussion a factor which is obscure. The processes that were responsible for endowing the colloidal complexes with the attributes of life, *i.e.*, "purposefulness in the development of the inner structure adapted to carry on definite vital functions", remain yet undefined.

The book constitutes a distinct contribution to the existing literature on the origin of life. The translator has earned the gratitude of the English-knowing public for making Prof. Oparin's thesis accessible to them.

Portraits of Eminent Mathematicians. Portfolio II. By David Eugene Smith (Scripta Mathematica, New York), 1938. 13 Portraits. Price $3.

This portfolio, the second in the series, contains the portraits and brief biographical sketches of thirteen eminent mathematicians, whose contributions to the science of mathematics are of a permanent character. It includes such distinguished names as Euclid of Alexandria, unique as a text-book writer; Cardan (1501–1576), the foremost Italian mathematician, a genius without principles;

Kepler (1571–1630), the brilliant astronomer, dogged by illness and poverty, who became the Professor of Astronomy and Mathematics at Graz at the age of 23; Fermat (1608–1665), a most retiring man of science who gave no attention to mathematics until he was over 30 years of age; Pascal (1623–1662), whose life was brief but brilliant, a man of delicate health, who had "never passed a day without pain from the age of 18"; Euler (1703–1783), who could calculate without effort "as men breath and eagles sustain themselves in the air" and though handicapped by the loss of his right eye at the age of 28 and his left eye at 59, continued his studies with the assistance of his son; Laplace (1749–1827), famous for his efforts to educate the educators, to raise teachers to the rank of scholars; Cauchy (1789–1867), the conceited mathematician, born poor but achieved success in later life, the author of about 800 important *memoirs*; Jacobi (1804–1851), a German scholar well known for his work on Elliptic Functions; Hamilton (1805–1865), the Irish infant prodigy, who could read English fluently at 3, perform mental long operations with numbers at 12, and was looked upon as an outstanding scholar of international standing at the age of 17, well known for his work on Quaternions; Cayley (1821–1895), the English mountaineer-mathematician, who spent a good deal of his time in reading novels and published 967 papers; Chebishef (1821–1894), one of the two greatest mathematicians of Russia, generally looked upon as the founder of the Russian school of mathematics, who chose a life of struggle and poverty in order to continue his mathematical career and lastly Poincaré (1854–1912), with feable eyesight but remarkable memory, with no remarkable ability for mathematics as a youth, but grew up into one of the greatest mathematicians of all times. These are scientists whose biographies are briefly recorded in the portfolio. "You may think", says the author in his Introduction, "that if you only had a fortune, if you had been born in luxury, and if you 'only had a chance' in this world, your name might be known in every city, State and country. A study of the lives of those who became known as leaders in the fields of mathematics, natural science, engineering and their related subjects, will show you that great renown may be achieved by those of humble birth and seemingly hopeless 'chance'." How true these words are can be realised by a study of the biographies recorded in this valuable work.

Wood Pulp. By Julius Grant. (Chronica Botanica Co., Leiden), 1938. Pp. 209. Price 15*sh.*

The above work, which has been published by Chronica Botanica Co., Leiden, Holland, as Vol. II of *A New Series of Plant Science Books*, presents in a fascinating and realistic manner the complete story of wood pulp, on which industries of great economic importance and vast magnitude, *e.g.*, paper and rayon, are based and which is the parent substance for a number of other promising industries, *e.g.*, power alcohol, sugars, explosives, plastics, constructional materials and so on.

In the first chapter of the book, the author prepares the ground by giving a general introduction to the definition and nature of wood pulp and its relationship to other fibrous materials, the geographical distribution and conservation of 'Wood Pulp Forests' (this might have been better put as 'Pulp Wood Forests') and the classification of pulp woods. After giving a historical survey of Paper-making and Manufacture of Wood Pulp in the second chapter, the author leads the reader on, in the third chapter, to a brief account of the chemical properties, compounds and structure of cellulose and of the structures of fibres and the growth of trees. In conformity with the purpose of the series to which the book belongs, a reference is then made in the fourth chapter to the anatomical, physical and chemical methods of identifying and evaluating pulp woods. With this foundation the author proceeds, in the next seven chapters, to give essential details, involved in the manufacture of mechanical and chemical pulps from wood. Without going into too many technical and engineering details, the author lucidly and briefly explains the theory and practice of the principal established processes, *viz.*, (1) the mechanical or groundwood process, (2) the sulphite process and (3) the alkaline process (soda and sulphate processes) together with the chemistry and methods of recovering alkali from these processes. No mention, however, is made of the neutral sodium sulphite process, perhaps because this process has hitherto found only a limited

application. The nature and properties of pulps obtained by each process and the uses to which they are put are discussed along with each process. The next three chapters deal with the chemistry and modern practice of bleaching, purifying and refining the pulps. In the following chapter an interesting account is given of the work done on the possible utilisation of the various by-products arising from the operations of pulp manufacture by the three main processes. Physical and chemical tests for the evaluation of pulps for paper, rayon and similar purposes and identification of fibres are embodied in a brief but clear manner in the next two chapters. The next chapter deals with the processes employed in the conversion of pulp into paper and boards. The first half of the next chapter summarises the type of paper for the manufacture of which the various grades of wood pulp are available and the processing of papers for the manufacture of speciality products, *e.g.*, chromo and art papers, vegetable parchment, vulcanised goods, waxed and waterproof papers, cheque papers, photographic papers, and so on. The next half of the chapter deals with the production of rayon and allied products, *e.g.*, staple fibres, dopes, lacquers, plastics, explosives, photographic films, etc. In the last chapter the author addresses himself briefly to a consideration of the numerous other miscellaneous uses to which wood pulp has been put in recent times, *e.g.*, moulded products, constructional and building boards and materials, toilet requisites, imitation leather, pulp yarns, textile products like "cellwolle", cellulose sponges and so on. The book is concluded with an interesting discussion on the future supplies of pulp wood and other fibres to meet the multitudinous variety of the ever-growing demand for paper and allied products in modern civilization.

The thorough and practical handling of a vast subject of such widespread interest and importance, in the course of 20 chapters, covering only 202 royal octavo pages, is indeed highly commendable. The bibliography of books and periodicals on pulp and paper-making at the end of the first chapter, a subject and name index at the end of the book and generous references to literature throughout the text, add greatly to the value of the treatise. It is, therefore, hoped that the book would prove of use and interest not only to those who are actually engaged in the pulp and allied industries, but also to students, who wish to add to their knowledge of the technical aspect of these industries. Dr. Grant is to be heartily congratulated on his able and praiseworthy performance.

M. P. BHARGAVA.

Tantalising Time. *Actualites Scientifiques et Industrielles*—Par Joseph Sivadjian—Vol 2, No. 616, 18*fr.*; Vol. 3, No. 617, 20*fr.*; Vol. 4, No. 618, 15*fr.*; Vol. 5, No. 619, 10*fr.*; Vol. 6, No. 620, 10*fr.* (Herman & Cie, Paris), 1938.

Down the ages, since the dawn of rational human speculation, philosophic and scientific thinkers have attempted to solve the problem of *Time*, and even at the present day, notwithstanding the staggering progress achieved by the laboratory sciences, it would be impossible to state that the problem of *Time* has been satisfactorily solved. The booklets or pamphlets under notice are thus welcome as they deal with the analysis of the concept of *Time* from different angles of critical vision. Of these, the second volume deals with specifically or distinctively metaphysical problems with pointed reference to Neo-Platonic ramifications and Scholasticism. *Time* was once understood to be "law of phenomena". In the third volume, *Time* is sought to be grasped through the *Psychological* approach. Reference is made to the view that *Time* is the "form of consciousness" to "formation", "duration" and allied topics. In the fourth, the "Physical problem" in respect of *Time* is discussed. "Spatio-temporal continuum", "Relativity", "Reversibility of space" and "Irreversibility of time" "Atomic measure of time and space" figure prominently in this volume. *Time*, understood as a physiological problem, is the subject-matter of the fifth volume. After pointing out the physiological basis of time, the author notes that animals are not devoid of the sense of time. Perhaps Plant-life too has a characteristic sense of time. In the sixth volume, *Time*, understood as a problem of the subconscious, receives a fairly detailed study. After a brief analysis of the notion of Time in dreams, questions are referred to such as—Is there time-sense in dreams? Do we transcend time in dreams?—and so forth. The author indicates the conclusion that there is no time-sense in dreams. Dreams and hallucinations are analysed and

their *differentia* noted. The Relativity of time is emphasized.

After a fairly careful study of the contents of the volumes under notice, I find that the concept of *Time* continues to be as tantalising as ever. Except within the circumscribed sphere of the physicist and the mathematician, time-space, that mysterious commingled entity, has not been properly understood. Centuries ago, *Nyaya-Vaiseshika* thinkers decided that *Time* and *Space* are irreducible, independent cosmic constituents. *Kāla* (Time) and *Dēsa* (Space) were considered to be independent substances (*Dravyas*). While scientific orthodoxy everywhere means a dictatorship to which implicit allegiance or obedience is demanded, the uninitiated man in the street is generally unwilling to bow to such dictatorship. Attempts to reduce time to space, space to time, and create *time-space* or *space-time a la* the super-man of Shaw must appear unconvincing to the commonsense man. Philosophic or metaphysical thinkers, full of years and wisdom, quibble about "Time is in a person", "A person is in time", and so forth. In the ultimate analysis, *Time* is identified with the Absolute, the cosmic Creator Himself. (The *Gita* text has it—"*Kalosmi-lokakshayakrit*"—I am Time, the Destroyer of the worlds.) In the peculiar program of psycho-physical purification or perfection adumbrated by YOGA, *Time* is understood in purely physiological terms in reference to inhalation and exhalation, and control of both is believed to lead to extraordinary experiences. Astronomers still delightfully speculate about life on other planets. If Mars is at all inhabited, what sort of a time-sense would the denizens of that ruddy planet have? Speculations like these must show that *Time* must for ever continue to be tantalising.

Not time, but the effects of time, are so devastating that man desires to escape from them. Hair-dye, powder, and cold-creams with the amusingly adventitious aid of which advancing age and its inevitable effects are sought to be checked, though in a familiar and flippant atmosphere, indicate a profound truth, the basic significance of which had been correctly appreciated centuries ago by ancient Indian master of thought. *Time* means *motive* or motivation. Motive means *action* ethically or morally good or bad. *Action,* in its turn, means imprisonment or bondage in a series of births and deaths in the labyrinthian den of transmigration. Release from this sort of imprisonment has been held the goal of life, of man's moral effort and endeavour.

Thus, the concepts of *Time* and *Eternity* continue to baffle and tantalise mankind. Whether we have an "Expanding Universe", or a CONTRACTING UNIVERSE, whether Evolution is emergent or creative, the tyranny of *Time* is there. The irreversibility of time is the most sensational phenomenon. A moment lost is lost for ever. Recall is possible in the shape of memory-imagery. But a recalled bit of experience is not the experience itself in its original setting, and intensity of intellect, emotion, and volition. That is why Buddhism and the Vedanta, though metaphysically poles asunder, yet agreed on the importance of *Time*. Life may be long or short. While we live, let us live correctly, morally and spiritually. That is a message, the value of which is untouched by the passage of *Time*. Time flies and the rest is lies, observed old Khayyam. *Fugit tempus.* Beyond this, even the modernest Science does not seem to have advanced. On the depth of thought revealed the author of the booklets deserves to be sincerely felicitated.

R. NAGARAJA SARMA.

Text-Book of General Zoology. By W. C. Curtis and M. J. Guthrie. Third Edition. (John Wiley & Sons, New York; and Chapman & Hall, London), 1938. Pp. 682. Price 18*sh.* 6*d.*

The authors have endeavoured to make this edition of their book more exhaustive than the previous editions; and the present volume contains nearly a hundred pages more than the second edition. The chapter on the History of Zoology has been omitted and in its place an introductory chapter with a list of books of general interest has been added. An important addition to this book is a chapter on Chordata which had been a serious omission in the earlier editions. Some portions of the book have been revised, and illustrations of typical animals of various phyla are a useful feature of this book.

In these days of intense specialisation in Zoology, it is relatively rare to come across a book dealing with various aspects of Zoology which would be helpful to a beginner or a layman. The book under review fulfils this requirement and it is truly a "General

Zoology" containing brief but clear account of almost every aspect of Zoology. Topics like Nervous Co-ordination, Experimental Breeding, Sex Determination, to mention only a few, have been detailed in such a manner as to enable a layman interested in the principles of Biology to follow them with minimum effort. This book would form a very useful addition to the libraries in the Colleges and High Schools in India.

On page 510, an illustration of one of the Gobioid fishes has been wrongly labelled as *Anabas scandens* and it is hoped that this error will be rectified in a future edition of this valuable book. A. S. R.

Plant Ecology. By J. E. Weaver and F. E. Clements. Second Edition. (McGraw-Hill Publishing Company, Ltd., London and New York), 1938. Pp. 601. Price 24*s*.

The first edition of this notable text was published in 1929, but the marked progress that has taken place during the last decade in the field of ecology has already led to some important changes in the present edition. The number of pages has increased by 83 and more than 400 new references have been added to the Bibliography. The whole text is generally brought up-to-date but the most important additions are concerned with soil science and the conservation of water and wild life. The value of the book is enhanced by the fact that it contains much practical advice on the methods of ecological study.

The text seems to have been written primarily for American requirements, but teachers, research workers and post-graduate students in India will also find it of great value. It is hoped that in the next edition the authors will also try to include some of the work done by Indian Botanists in this line. P. MAHESHWARI.

Biology for Senior Schools. Book I. By M. R. Lambat, M.A. (Macmillan & Co., Ltd., London), 1937. Pp. 218. Price 2*sh*. 6*d*.

With the increasing appreciation of the fundamental value of science teaching in secondary education, the study of life through Plant and Animal Biology is regarded as an essential part of child training. The object of such a study is to stimulate the natural curiosity of the child which usually finds expression in the why, what and where of things in general. If the scheme of studies should contemplate such an instruction by well-planned and intelligently guided scheme of investigations into the natural history of the Animal world, we have no doubt that the child is not merely initiated into the mystery of Life but would also be equipped for good citizenship.

The book under review is a well-planned book on Elementary Biology and is a successful attempt at creating the student's interest in biological studies. An animal or a plant could be studied from various aspects. Its structure, both external and internal, its functional activities, its relations to the animate and inanimate environment and its developmental history are a few of the aspects of such a study. It follows therefore that the study of Biology in the field would be the most successful and useful one.

Within a short compass, the author presents an extremely interesting and instructive account of plants and animals and as an introduction to biological studies, the types selected are thoroughly representative besides being the commonest. The first nine chapters deal with the attributes of living organism and bring out lucidly the essential differences between plants and animals. This aspect is fundamental as it emphasises the Unity of Life and gives the student an idea of his own position in the animal kingdom.

In the later chapters the author gives an idea of seasonal changes, both in animals and plants and describes in an easy manner the functions of the different parts of a typical plant. The last four chapters, brates, are useful in the sense that without going into details, the author describes the animals with reference to their feeding, movement and reproduction. This it seems to us, would stimulate in the student interest in the subject without developing in him a horror for minute structural details.

At the end of each chapter, suggestive questions are included. The simple experiments described to demonstrate the various functional activities of plants and animals are valuable for a correct appreciation of the subject-matter. The book is well illustrated and the get-up is good.

We recommend the book to all High Schools where Biology is taught as part of the Secondary Education. B. R. S.

Electron Optics. By L. M. Myers. (Chapman & Hall, Ltd., London), 1939. Pp. 618. Figs. 379. Price 42*sh.*

The expression "Electron Optics" was used by Dr. Davisson, twelve years ago, to describe the interference of the electron waves. The book under review, however, deals with the geometrical optics of the electron, moving in non-homogeneous fields. The chief contributions to this science have been made by the German and the American workers. The two books, *Geometrische Elektronenoptik* and *Beitrage zur Elektronenoptik*, are well known; no authoritative text-book on the subject of Electron Optics was published in the English language, and so the author, who is associated with the Marconi Company, comes forward with the present volume.

In this book, Mr. Myers gives an exhaustive treatment of the subject; both theoretical and experimental details are included in the book. He first compares the electrons with the light corpuscles, then treats the electron trajectories mathematically, and finally, he describes the various methods to build the electron multipliers and microscopes and how they may be used. The Bibliography at the end of the book would be very useful to the worker in this field.

Without hesitation I would recommend the book to an Electron Optician. But I do not think that the author's claim that the book is written primarily for the graduate student, who intends to take electron optics as a career, can be substantiated. The large number of errors left behind in proof-reading, specially in the mathematical treatment (*e.g.*, not less than 30 in Chapter II) make the book rather unsuitable for a graduate student. The impression is produced that the book was rushed through the press.

K. R. DIXIT.

Agricultural Marketing in Northern India*

THOUGH the literature on the subject of the marketing of agricultural products is rapidly increasing, much of it covering the same ground, drawing attention to the same drawbacks and suggesting more or less the same methods of improvement, the field cannot by any means be considered to be fully covered or the points of view exhausted. The importance and complexity, moreover, of the subject in respect of such a large continent like India with its wonderful diversity of agricultural products, and the fact that so little has been accomplished by way of improvements in marketing methods in spite of these studies justify a larger and larger amount of attention being bestowed on the subject. It is from this point of view that we welcome this new publication as a further helpful study. Though the author has confined his study to the main products of Northern India such as wheat, sugar, rice, oilseeds, cotton and jute, it is obvious that to a great extent his observations and conclusions will apply to other parts of the country as well and to many other kinds of products also. The restricted scope may be said also to increase the thoroughness and the accuracy of the book while the commodities dealt with practically comprise the main products of the country as a whole at the same time. The author has laid all the important published literature on the subject fully under contribution, with the exception of the results of the recent marketing surveys by the Government of India, and the book is fully documented.

The need for an improvement in the prices of agricultural produce in general, both in the overseas market and within the country itself and for securing to the grower as large a share as possible in this price as distinguished from the share of the merchants and middlemen are the main themes and both receive adequate attention. Much familiar ground is covered but many of the observations will bear emphasis and repetition. The great slump in the prices of produce and the consequent depression are attributed to merely overproduction; the causes, mainly political, economic and fiscal, which have led to a shrinking in the purchasing power of the masses are, we think, not given the importance they deserve in this perplexing situation. The author's remarks on the value of the preferences under the last

* By S. H. Husain, B.Com., Ph.D. (Econ.), with a Foreword by Sir Harry Lindsay, K.C.I.E., O.B.E., London. (George Allen & Unwin, Ltd., London), 1938. Pp. 342. Price 15/-.

Ottawa Trade Agreement are interesting; Indian castor holds the market by virtue of its high quality, the preference to groundnut is shared by the Colonies also who are India's chief rivals; in respect of linseed, it is a case of taking away with one hand of what has been given with the other—a view which is supported by facts and figures. In respect of cotton, however, the author would have us cultivate and retain the goodwill of the overseas markets and would probably support the sacrifice which the mill industry has been asked to make for this purpose under the new agreement. We also venture to think that the importance of judicious protection might well have been emphasised a little more, especially with the example of the Indian sugar industry before us which, by the way, receives fairly exhaustive treatment. Improvements in quality of produce, cleanliness, freedom from mixtures and grading are of course dealt with in this connection and the author draws attention to the fact that such special produce fails to secure the premium that it is entitled to and that the incentive is not, therefore, sufficient. The need for widening markets, for scientific research for finding other uses than the well-established ones, and for special efforts to advertise are indicated, the example of the Indian tea industry being held up as a model and that of the Indian jute industry as a warning. "Living in the paradise of monopoly and basking in the sunshine of high prices", the jute industry has grossly neglected its permanent interests and now has to helplessly look on while its markets are steadily shrinking with the rapid growth of other methods and materials of storage.

As regards internal markets and the improvement of the position of the grower *vis-a-vis* the merchant, the subject of transportation, both by road and rail, of regulated markets of linseed warehouses, of storage facilities, of financial assistance for holding up produce and sale through co-operative societies, all receive clear and forceful treatment. We should strongly plead with the author for the provision of proper storage facilities, both in the primary and the central markets. The underground structures, both *katcha* and *pucca*, and even the cement concrete improved ones should be replaced by good above-ground bins, preferably of the elevator type. The present ones are primitive to a degree and are relics of a troubled past, when grain stores had to be hidden quite as much as gold and silver. The wastage is large even at the best of times, and all but complete if conditions are unfavourable. Labour at these stores is no holiday occupation and poverty and custom alone ensure it at present. It is no argument to say that the failure of the costly Lyallpur Elevator was not a success; the author fully explains the reasons and we would only add that changes considered novel and unsuitable not many years ago have become the common practice under the rapidly changing conditions in India. The mistakes of the past can easily be avoided and smaller and less costly types of elevators suited to the conditions of the ordinary *mundies* can be erected. The inadequacy of finance through co-operative agencies is forcibly brought out by the instance of the U.P., where out of 124 crores of rupees of rural debt, only about 4 crores comprised amounts advanced by Government and co-operative societies put together! It is true that co-operative sale societies have not been a uniform success but there is no other method which holds promise of help to the grower more than these institutions. The author's remarks on the failure or partial success of the Commission shops of the Punjab and why ryots do not patronise them in spite of the decided and undoubted advantages they afford are valuable and reveal the kind of mistakes to be avoided. The author has throughout stressed the need for making agriculture more paying than it is at present if any real and permanent amelioration is to be brought about and for increasing production all along the line, taking full advantage of the results of research in reducing costs, avoiding losses, and increasing yields. As observed in the *Foreword* to the book by Sir Harry Lindsay, "there is no shortcut to a solution of the problems which the author has so well described", but the general lines of attacking them along a wide front are comprehensively indicated and we should consider the book a welcome contribution to the rapidly growing literature on this subject.

A. K. Y.

Trout Culture in Ceylon

THE recent treatise of Mr. Philip Fowke, Superintendent of the Ceylon Fishing Club's Hatchery at Nuwara Eliya, on "Trout Culture in Ceylon"[1] should prove of special interest for all connected with Trout Culture in India. The work is of special significance as it is the first of its kind that deals in a comprehensive manner with trout culture in Indian waters (*sensu lato*); the information regarding the cultivation of trout in these waters so far published is contained in a number of short and scattered articles in various journals and is not easily available.

The author has confined himself to the culture of the Rainbow Trout, as Brown Trout are not bred in the Ceylon Hatcheries, partly owing to the comparatively higher temperature of the water, but mainly owing to the fact that in Ceylon the cock and hen fish are never in season at the same time. The latter is a very important point for pisciculturists, as workers are liable to fertilise ripe ova with unripe milt with disastrous results.

Mr. Fowke deals with the culture of the Rainbows in eleven sections: Introduction of Trout in Ceylon, Spawning and Stripping, Hatchery, Nursery Ponds, Conditioning and Transport of Fry, Transport of Eyed Ova, Care of Streams, and finally, the Wanderings of the Rainbow Trout. After giving a brief description of the Nuwara Eliya Hatchery and how Trout were introduced in Ceylon, the author discusses in detail the spawning and stripping operations and gives an account of the origin and history of artificial fertilisation and up-to-date hatching methods. He directs particular attention to the desirability of removing dead eggs daily before eyeing without disturbing or injuring the remainder, as this has been the main reason of the great success of piscicultural operations with the Rainbow Trout in Ceylon.

In the section on Mortality of Trout, a brief account is given of the various diseases that attack young and old fish in Ceylon. This subject, although widely studied in America and Europe, has, owing to the lack of research facilities in the hatcheries, received very little attention in India. The account of the construction of Fry and Nursery Ponds, Conditioning and Transportation of Fry and Ova, though mainly based on the conditions in Ceylon, should prove of value to pisciculturists in various parts of India also. The great success achieved in transporting fry without changing the water in Ceylon is very interesting.

In the section dealing with the care of streams, the outstanding features are the choice of waters for the Brown and the Rainbow Trouts, the methods for providing and conserving food and the marking of fish for studying their movements, growth, etc. Special reference is necessary to the observations on the wanderings of the Rainbow Trout in Ceylon. It was till recently a puzzle to all trout culturists in India as to why the Rainbows disappear from all waters. The author has now shown that what is regarded as the freshwater Rainbow is in reality a different species, the *Salmo rivularis* or *gairdnerii* or the steelhead which is an anadromus fish. The number of lateral line scales, which, according to the author, is a character of considerable diagnostic value, serves to distinguish this species from the purely freshwater *Salmo shasta*. It would thus appear that the disappearance of Rainbow from Kulu and some of the Kashmir Trout streams may in reality be due to the instinctive migratory habits of the species, as all the Rainbows introduced in India proper are the progeny of the same stock. The author suggests that efforts shoud be made to produce a strain of Rainbows from which the wandering instinct has been eliminated, but before any step is taken in this direction it is important to determine the nature and extent of the wandering of the species. In this connection, it is very significant that the U.S. Bureau of Fisheries, in co-operation with the State of California, is rearing several strains of Rainbows in the hope of eliminating the wandering instinct. In this connection, a question arises as to which factor or factors determine the wandering habit of this species, since it spawns freely in fresh-waters and also finds plenty of suitable food in this *milieu*.

The descriptive account is accompanied by a number of beautiful illustrations of filtering, hatching and distributing troughs; pools, lakes, fry and nursery ponds, etc.,

[1] *Ceylon Jour. of Sci.*, Sec. C, *Fisheries*, Nov. 21, 1938, **6**.

and a layout plan of the Nuwara Eliya Hatchery. The author is to be congratulated on the production of a treatise which should not only be of great interest to all those interested in Trout Culture in tropical waters, but also serve as a work of reference in all Trout Hatcheries.

GULAM MUSTAFA MALIK.

Larvicidal Fishes and Their Identification

MALARIA is one of the major scourges of India and its prevention and cure have engaged the attention of the Medical and Public Health authorities in India for well over quarter of a century. The problem of the prevention of Malaria is many-sided, but from the time of the discovery by Sir Ronald Ross that the Anopheline mosquito was the carrier of the malarial parasites, it has been the aim of the authorities to control the incidence of Malaria by controlling the breeding of the carrier-mosquitoes in various ways. It has been known for many years now that some species of Indian freshwater fishes have a special preference for mosquito larvæ as food, and that their introduction into tanks, ponds and wells would go a long way to control the mosquito population in the neighbourhood of human dwellings. Medical men naturally turned their attention to the fishes of the aquatic areas in which mosquitoes bred, but found themselves in difficulties in the identification of the fishes. The only standard works on the Fishes of India were none too easy to refer to, burdened as they were with a mass of technical details, and the result was that fishes were often wrongly identified, sometimes not at all. The medical man, who is a field-worker interested in the control of Malaria by the use of larvicidal fishes, would appreciate a simple guide to the identification of freshwater fishes in India. In respect to this, *Health Bulletin No.* 12, *Malaria Bureau No.* 4 (Second Edition, Revised and Enlarged), pp. 1–47, pls. i–vii (1938), by Dr. S. L. Hora and the late Mr. D. D. Mukerji, of the Zoological Survey of India, seems amply to fulfil the needs of medical men in the field. The *Bulletin* bears the title "Table for the Identification of Indian Freshwater Fishes, with descriptions of certain families and observations on the relative utility of the probable Larvivorous Fishes of India"—a sufficiently self-explanatory title which renders a review somewhat superfluous. Nevertheless, the value of a neat and useful compendium of information on Indian Freshwater Fishes, like the present *Bulletin*, will hardly suffer by emphasis on its merits.

To the medical man in the field with the best will in the world, a reference to a well-arranged identification table of Indian Fishes would be of little help if he has not only to face terms like "procumbent predorsal spine" or "pro-current caudo-dorsal", but also to find the structures referred to in the fish under examination. The few pages devoted to the explanation of the principal terms and of the modes of measurements used in the description of a fish are, therefore, a very useful prelude to the Table of Identification which, with the eleven clear sketches of the external morphology of fishes (text-figures 1–11), renders the task of identification easy. The Table deals with 59 families of fishes, of which 11 are known to be larvivorous. The generic identification of the larvivorous families of fishes is facilitated by the inclusion of keys in footnotes, but a separate generic key of the Cyprinidæ is given as this family includes several genera of potential utility in anti-malarial work. The three appendices which follow are at least as valuable as the Table of Identification. Appendix I contains descriptions of exotic and Indian families of probable larvivorous fishes with information of value to those interested in mosquito-control work, printed in italics or in thick type. Appendix II contains notes on the relative importance of the various exotic and indigenous species of fish as destroyers of mosquito larvæ, and deplores the fact that no serious attempt has been made in this country to elucidate the value of exotic and Indian species of fish as destroyers of mosquito larvæ under Indian field conditions. A useful list of references on Malaria and mosquito control and on larvicidal fish follows. In Appendix III it is pointed out that the rough identification of the fish in the field should, in many cases, be followed by expert identification which is possible only in institutions with large reference collections of fish and literature such as are available in the Indian Museum. The collection and preservation of fish, simple as they appear, need a little expert guidance, and the authors give in this appendix a few simple directions as to how fish may be

observed in their natural haunts, how they may be collected and preserved if wanted for museums, or how they may be transported alive when required for anti-malarial work. The seven plates at the end with clear dot and line drawings of Indian freshwater fishes which enhance the value of this little *Bulletin*, should help not only medical men, but also students of fishes, to familiarise themselves with the features of some of the principal Indian larvivorous fishes.

The *Bulletin*, which is priced at 7 annas or 8*d*. a copy, is published in Delhi by the Manager of Publications, and may be obtained from the Agents to the Government of India Publications in India and from private book-sellers, a list of which is given on the page opposite to the Prefatory Note.

H. S. R.

OBITUARY

Dayaram Sahni, M.A., C.I.E.

RAI BAHADUR DAYARAM SAHNI, M.A., C.I.E., late Director-General of Archæology, died suddenly on the 7th March 1939 of heart failure at Jaipur, where he was employed as Director of Archæological Researches since 1935. Rai Bahadur was the first Indian to be trained in the modern methods of archæological excavations, and by his death India loses a most experienced archæologist.

Rai Bahadur belonged to a respectable family of Khatris from Bhera in Shahpur District, Punjab. He was born on 16th December 1879. After passing his M.A. from the Oriental College at Lahore, with Sanskrit as his main language, he was selected for the archæological scholarship instituted by the late Lord Curzon's Government, with a view to preparing suitable Indian scholars for archæological work. Sir John Marshall, who was then organising the first systematic campaign of excavations in India, found in Rai Bahadur a willing and capable assistant. He worked at the excavations conducted by the Department at Sarnath near Benares, Kasia, the scene of the Great Buddha's decease. Sahet Meheth, the ancient Sravasti, Rajgir in Bihar, Mandar near Jodhpur, and Rampurva in Champaran. At Sarnath, Mr. Sahni studied the finds and prepared a comprehensive catalogue and a guide to the ruins. After a year, at the Lucknow Museum, where he worked as Curator, Mr. Sahni's services were lent to the Kashmir State, in December 1912. During the next four years, Mr. Sahni studied the architectural remains in Kashmir, and excavated at several places, among which may be mentioned Avantipur, the city of Avantivarman, Parihaspur, Hushkur, and Martand, the well-known site of a temple in classical style. In 1917, Mr. Sahni returned for work, to Lahore, where he took over the Hindu and Buddhist monuments in the United Provinces and Punjab to his charge. After carrying out important archæological work at Deogarh, Sarnath and other places in the United Provinces, Rai Bahadur Sahni then commenced a series of excavations at Harappa, which was shortly afterwards recognised as the foundation of our knowledge of one of the earliest cities of the Indus Valley culture. Since 1925, Rai Bahadur Dayaram Sahni was engaged at the Headquarters of the Government of India, first as a Deputy Director-General, and finally in July 1931, when he became Director-General. Unfortunately, his advent coincided with an era of unprecedented curtailment of activities owing to the need of retrenchment and his three years' tenure as Director-General was consequently very much handicapped and the lowest watermark of funds allotted to this cultural activity was reached. However, he carried the Department through this period and on retirement found fresh scope for his capacities in the almost untapped and rich archæological field in the State of Jaipur. His excavations at Birat, where he unearthed one of the earliest Buddhist *stupas* in Rajputana, were highly successful. He carried out one or two seasons' work at the ancient city site of Naliasar-Sambhar near the well-known salt lake and at the time of his death was engaged in another important excavation at Rairh where he had hit upon another rich site of the early period.

Rai Bahadur Sahni was awarded the title of C.I.E. after his retirement in 1935.

Besides the two publications on Sarnath, Rai Bahadur contributed numerous other articles to scientific journals, particularly on Epigraphical subjects, bringing to light and interpreting many records of the past, particularly from the United Provinces and Northern India.

INDUSTRIAL SECTION

The Chemistry of Detergents

By K. Venkataraman, D.Sc. (Manch.), F.I.C., A.M.I.Chem.E.
(Department of Chemical Technology, University of Bombay)

A DETERGENT is broadly defined as "a washing or cleansing agent such as soap, scouring compositions, etc." and detergency as washing or cleansing. The detergent action of the alkalis and of certain of their salts such as the silicates and phosphates is well known and, more recently, the detergent action of colloidal clays has been recognized. Soaps were the earliest organic detergents and, although numerous synthetic organic detergents with certain advantages have been evolved, the soaps have by no means been abandoned in detergent practice on account of their fundamentally valuable properties and their cheapness. In fact the synthetic detergents are in general not as satisfactory as soap for the usual fabrics, so long as the water is soft. The detergent action of alkalis may be partly attributed to the soaps formed from the saponifiable matter present in the material being deterged, and the action of colloidal clays to their adsorptive capacity. Used in conjunction with soap, the addition of colloidal clay increases lathering power, makes a firmer and more powerful lather, and absorbs and neutralizes free alkali.[1] The washing of textiles, hair or skin with a detergent composition containing a sulphonated product of the Igepon type and a colloidal clay like Bentonite has been claimed (*Fr. Pat.* 820,661).

Much attention has been directed in recent years to the mechanism of detergent action. Partly as a result of the truer insight now available into the many factors governing detergent action and of the more stringent necessities of modern textile processing with regard to the delicate nature and variety of the fabrics and to the importance of the time factor in production, it has been possible for the synthetic organic chemist to arrive at substances which are efficient detergents and which have in addition to their detergent action a number of desirable properties which enable them to be used under widely varying conditions.

In a recent symposium[2] organised by the International Society of Leather Trades Chemists a very comprehensive and illuminating survey has been made of the theoretical aspects of wetting and detergency. While the newer concepts of the physics and chemistry of surfaces, due to Freundlich, Hardy, Langmuir, Adam and Rideal, have led to better understanding of the arrangement of detergents and emulsifying agents at interfaces and of the molecular forces which play a part in the gradual accomplishment of the ultimate result of detergency, this has simultaneously complicated the work of the manufacturer of textile auxiliary agents, since the processer has begun to realise that the detergent for a given purpose and set of conditions may be entirely unsuitable under other circumstances. To the synthetic organic chemist, however, the broadening of the theoretical bases of detergent action and the quantitative considerations and methods that have emerged in consequence have meant the opening up of a new and extensive field of research.

A wetting agent need not *per se* be a detergent, but in general wetting or penetrating power towards textile fibres is a desideratum in a detergent. Whatever may be the theory finally adopted regarding the mechanism of detergent action, it is as necessary for a detergent as for a dyeing process that the reagent must initially come into intimate contact with the surface of the textile material. Adsorption should then take place, the detergent having a greater attraction for the surface to be deterged than the grease, oil or "dirt" which is to be removed. Rideal[2] has suggested that detergents, like dyes, are first adsorbed on the outer surface of the fabric and then migrate into the interior accessible surface. The oily or greasy film is then loosened on account of its displacement by the detergent, the oil collecting into comparatively large globules.[3] Dependent on the agitation to which the scouring liquor and the deterged surface are submitted and the emulsifying power of the detergent or of a second added substance, an emulsion of the oil may be formed or the

oil may be removed by a process of flotation. The last factor which determines the detergent efficiency as measured by any practical test, such as whiteness or wax content, would be the prevention of redeposition of the oil or dirt on the surface of the fabric; here presumably the protective colloidal power of the detergent is concerned. Rideal[2] considers that the polar head of a detergent may also fulfil a definite chemical function in addition to the more usually recognized physical function of rendering a hydrophobic surface hydrophilic in character; loose molecular complexes may be formed between the polar heads of the detergents and the alcoholic groups in the oil or grease or the keto-imide groups in protein "dirt". The hypothesis would be limited by the nature of the dirt and by the availability of detergents which do not possess a polar head or ionising group.

The two stages of adsorption at the interface and migration into the intermicellar spaces of a fibre may be difficult to demonstrate experimentally in the case of the common reagents not susceptible to identification by colour reactions. Anacardic acid, which is a constituent of cashew nut shell oil and, being a derivative of salicylic acid, gives an intense coloration with ferric chloride, should prove useful for studies in the mechanism of detergent action. Carrying a pentadecadienyl residue *ortho* to the phenolic hydroxyl, the sodium salt of the acid has marked wetting power and its detergent properties are under examination.

The factors involved in detergent action are so complicated that the problem of measuring the detergent efficiency of a given substance is beset with even more difficulties than the measurement of wetting power;[4] on the other hand a quantitative assay of detergency is fundamental to a study of its relation to chemical constitution. The physical properties usually determined, such as surface tension or interfacial tension in terms of the drop number, wetting intensities, contact angles, etc., are not related in any known manner to actual detergent power.[5] Zakarias[6] regards protective colloidal action as the essential criterion of detergent efficiency, but it is common knowledge that the two do not necessarily go hand in hand, judging detergent power by any practical test. In a discussion of soluble soap, insoluble soaps and synthetic detergents, Crowe[7] has briefly outlined theories of detergency and has referred to the dependence of the choice of a detergent for a given process on the process itself and on the composite quality of the detergent, rather than on the consideration of individual factors. The sulphonated oils (Turkey Red oil, Prestabit oil, etc.), whatever the degree of sulphonation may be, are devoid of detergent power in spite of possessing other valuable properties such as wetting, dispersing and emulsifying power. This contrast in properties, pointing to the more specific requirements in an organic compound to develop detergency, is further exemplified by the alkylnaphthalene sulphonic acids (Nekal BX, Perminal W, Oranit), which are powerful wetting agents, but not detergents. The distinct aspects of wetting and solvent action involved in detergency are recognized by the use of non-detergent wetting agents like the Nekals in conjunction with chlorinated and other solvents. Likewise it has been suggested that the detergent properties of the sulphated alcohols are improved by admixture with unsulphated alcohols; the contrary suggestion that the presence of unchanged fatty alcohol acts detrimentally on the detergent power of the sulphate has also been made.[8] The explanation probably lies in the relative amounts of the unsulphated alcohol present. A direct measurement[9] employing washing or kier boiling tests is essential. From the practical point of view the analysis of the factors underlying detergent action would indicate that the nature of the material to be deterged and the nature of the "dirt" to be removed are both to be taken into account in assessing the efficiency of a detergent; the conditions with regard to temperature, pH, etc., must also be closely defined. Confining oneself to a comparative study of the detergent efficiency of members of a homologous series, the determination of an individual property, such as interfacial tension or foam number, may give useful indications. Thus Götte[10] found that in the series $C_nH_{2n+1}-O-SO_3Na$ the maximum "washing effectiveness" at 60° corresponded to the maximum Steipel foam number. The alkaline washing effectiveness in soft water was a maximum at C_{16}, but it was observed that for every temperature and degree of water hardness there was an optimum alkyl sulphate. The maximum washing efficiency was displaced in the direction of increasing chain length with increase in temperature and in the hardness of the water.

In assessing the value of a detergent to be employed in textile processing, a factor of great importance is its stability to the reagents involved, particularly acids and alkalis. Resistance to hard water or ability to disperse calcium soaps[11] is another desirable characteristic. Used in soft water, soap is an excellent detergent and its survival, in the face of strenuous competition from a host of synthetic auxiliary agents, as still the most widely employed detergent is ample evidence of its value in this regard. Its chief drawback is its instability to acid and to metallic ions, such as magnesium and calcium. For the scouring of cotton materials, the reagent needs to be stable to alkali; substances such as Igepon A, Avirol and Aerosol OT, which are esters hydrolysable by boiling alkali, but have otherwise useful properties as wetting and emulsifying agents, would fail to function in a kier boiling operation.

While synthetic detergents are usually built on a soap model consisting of a hydrophobic and a hydrophilic half, quantitative examination of a series of detergents would readily show that the structural features that are favourable to the conferment of detergent power may to some extent be defined, but it is no more possible than in the case of the relation between chemical constitution and physiological action to arrive at forecasts of the constitution of substances with maximum detergent power. The precise degree of the detergent power is a specific property of a particular compound, depending on the interplay of forces between the various groups or atoms in the molecule.

On the basis of our present knowledge of the probable stages involved in detergency, and as a guide to synthetic effort, an ideal detergent may be postulated to have the following properties in the optimum degree: (1) affinity for the surface to be deterged; (2) solubilising or peptising power towards oil or grease; and (3) protective colloidal action. Other favourable factors are solubility in water and ability to function under adverse conditions, *e.g.*, in hard water and at wide variations of temperature, pressure, acidity and alkalinity. Solubility in water is not intrinsically necessary in a detergent, since the example of adsorbent clays as detergents has been quoted; but water-insoluble detergents can only function where the agitation employed is such that access of the detergent to every part of the deterged surface is ensured throughout the process; in any textile operation involving detergents, as in kier boiling, the fibrous material would act as a filtering medium and the detergent would be rapidly put out of action. A certain minimum solubility in water is, therefore, essential in a detergent for textile purposes.

Considering the three requisites in a detergent outlined above, fulfilment of the first would be dependent on the nature of the fibre, and the constitutional characteristics of a detergent for cotton and the cellulosic fibres would differ from those of a detergent for wool and the protein fibres. Experiments in this laboratory have naturally been concerned almost exclusively with cotton and, although they are still in the early exploratory stages, it has been possible to obtain some indication of the dependence of detergent power on the affinity of the reagent for the fibre or, as it may be termed by analogy with dyestuffs, on its substantivity. The nature of substantivity, which will be discussed elsewhere in more detail with reference to synthetical experiments in the Naphtol AS group, is still obscure. In the case of the polypeptide fibres containing free and potential amino and carboxyl groups, the explanation of their behaviour towards dyes and other electrolytes on organic, colloidal or electrochemical grounds can all be correlated. The nature of cellulose largely rules out the possibility of chemical combination; we are, however, now aware that the cellulose molecule is not as completely inert as usually conceived and the hypotheses, confirmed by X-ray evidence, of the constitution of cellulose as long chains of anhydroglucose units held together laterally by residual forces and of the micellar structure of the cotton fibre, are adequate to account for the behaviour of cellulose in processes such as mercerisation and towards dyes and other reagents for which it exhibits affinity. The dyestuff chemist has accumulated data regarding the structural features of an organic compound which are favourable to substantivity to the cotton fibre. Our knowledge of the subject, due mainly to Ruggli,[12] may be briefly set down as follows, in so far as it is relevant to the present purpose. (1) The substantivity of symmetrically constituted azo dyes has been explained by Meyer as due to the straight chains of the cellulose molecules attaching themselves, probably by means of covalencies,

to the straight chains of the dye molecules. The non-substantivity of disazo dyes from benzidine substituted in the *o*-position to the diphenyl linkage has been ascribed to alteration in the co-planar arrangement of the diphenyl rings, any deviation from a straight linear structure leading to diminished substantivity. The hypothesis has its limitations and exceptions, but it might offer useful clues to the relation between the substantivity of a detergent and the presence in the molecule of straight chains of carbon atoms which may lie adsorbed on the glucosidic chains of cellulose. (2) The effect of the acid amide group (-CO-NH-), as evidenced for instance by the much greater substantivity of Naphtol AS in comparison with β-naphthol, is well recognised. The admitted efficiency of a condensation product of oleic acid and taurine as an auxiliary in the scouring of cotton may be cited in this connection; the wetting and detergent properties of a series of compounds derived from fatty acids and aromatic amines, and possessing, therefore, the common feature of an acid amide group, have proved to be of practical interest.[5,13,14] Textile assistants are produced by condensing a sulphonic acid of phthalic anhydride with an amine containing a higher alkyl group, *e.g.*, methylhexadecylamine or *p*-aminostearanilide, the latter compound carrying two acid amide groups (*Brit. Pat.* 461,054). Perhaps the commonest method in the patent literature of bridging a long and a short aliphatic chain is by means of an acid amide group; *e.g.*, aminoacids (glycine, alanine, etc.) are acylated with high molecular fatty acids (*U.S. Pat.* 2,063,987; *D.R. Pat.* 635,522). Schirm's suggestion that enolisation of the acid amide group to -C(OH)-N- is responsible for the substantivity of Naphtol AS and his deduction therefrom that substantivity is due to the existence in a dyestuff molecule of a chain of conjugated double bonds must be subjected to more careful scrutiny. Assuming for the moment that substantivity plays a part in detergency, it should be noted that acyl derivatives of secondary amines appear in general to be more efficient than the corresponding condensation products of primary amines. On the other hand, a double bond conjugated with the carbonyl is favourable to substantivity, a cinnamoylamido group in a Naphtol being more effective in this respect than a benzamido group. (3) Conflicting results have, however, been obtained with regard to the general influence of unsaturation, as represented by a carbon-carbon double bond, on wetting and detergency. Thus the relative values of sodium laurate and oleate were frequently reversed when lauric and oleic acids were combined with various arylamine sulphonic acids. (4) Ruggli regards the sulphur atom as being favourable to substantivity; restricted to definite groupings containing sulphur, evidence may be advanced in favour of the suggestion. Primuline containing a thiazole ring is a well-known example of a substantive dye. The high affinity of sulphur dyes in sodium sulphide solution is probably associated with the formation of -SNa groups. So far as detergents are concerned, sulphonic, sulphuric and thiosulphuric groups are common features, though the evidence of their effect on wetting and detergency is not conclusive. Their influence in increasing solubility in water is obvious, but the introduction of acid sulphate and sulphonic groups does not necessarily improve wetting or detergent power; the opposite effect may frequently be encountered on account of the balance of the detergent being upset by the disproportionate influence of the ionising, hydrophilic part of the molecule. Wetting and emulsifying agents containing a sulphide linkage have been the subject of patents. One example is the sulphate of 2-hydroxyethyl cetyl sulphide (*U.S. Pat.* 2,100,297). Saponaceous organic sulphides have been described by Henkel and Co. (*Brit. Pat.* 470,717). Compounds having the formula R-SO_2-R'Y or R-SO-R'Y, where R is an aliphatic radical of high molecular weight or an *iso*- or heterocyclic radical, R' an aliphatic radical containing fewer than 8 carbon atoms and Y a water-solubilising group, are wetting, cleansing and dispersing agents (*Fr. Pat.* 809,373; *Brit. Pat.* 461,614). (5) The influence of heterocyclic rings in increasing substantivity can be illustrated by dyes containing thiazole, pyrazolone, iminazole, pyrimidone and other ring systems. Wetting, emulsifying and detergent products prepared from heterocyclic compounds have been claimed in recent patents. The sulphonation products of higher alkyl substituted indoles (*Swiss Pat.* 191,011) and imidazole derivatives (*U.S. Pat.* 2,053,822) are two examples. (6) The fact that synthetic wetting agents and detergents are in general polar compounds assumes a special significance in its relation

to the problems of adsorption and substantivity. As pointed out by Ruggli, non-polar molecules are apparently not adsorbed. With the necessary variations for colour on the one hand and the properties of detergency, etc., on the other, a certain analogy may be drawn between substantive dyes and anion-active textile assistants. The influence of the dipole moment on adsorption and substantivity should be of as much interest in the case of wetting agents and detergents as of dyes. (7) While the multiplication of sulphonic groups increases solubility and tends to reduce wetting and detergent power, Ruggli and Braun[15] noticed among a series of azo dyes that there is no relation between substantivity and water solubility. Measurements of the rate of diffusion indicated that all substantive dyes were colloidal and exhibited slow rates of diffusion, but all colloidal substances did not have an affinity for cotton. Substantivity was dependent on chemical constitution, rather than on physical factors, although the dependence of one on the other should be taken into account. The colloidal nature of the solution might in some cases lead to an apparent affinity for cotton, but absorption in such cases was reversible and of a temporary character, rinsing with cold water being sufficient to strip the fibre completely; true affinity should presuppose a definite degree of irreversibility or permanence in the attachment of the adsorbed material to the fibre. The studies of Conmar Robinson, Neale and others on the physical properties of aqueous solutions of substantive dyes have shown that substantivity is directly related to the ability of the dye molecules to form aggregates or micelles. McBain[16] regarded soaps as colloidal electrolytes, *i.e.*, as salts in which one of the ions was replaced by a heavily charged, heavily hydrated ionic micelle exhibiting a high conductivity. Chwala[17] defined most textile assistants as colloidal electrolytes, the properties of which depend on the balance of their colloidal and ionic components. This factor, to the importance of which in a wetting agent reference has been made by Dean,[2] is a vital consideration in the synthesis of detergents. While the tilting of the scale on the fatty hydrophobic part would diminish the solubility in water, and increase the solubility in organic solvents, and *vice versa,* the special properties of the substance as a wetting agent, detergent, etc., would depend on the nature of the two halves and on their balance. Colloidal character would appear to be much more necessary in a detergent than in a wetting agent. Hartley[18] has characterised detergents as "amphipathic", indicating their unsymmetrical duality of affinity, and has demonstrated that they form micelles in solution. Micelle formation was found in some cases to run parallel to detergent action.

Classifying surface-active substances as anion-active and cation-active,[19] the latter have normally no practical interest as detergents, but they have other extremely valuable properties, which have led to their increasing use as stripping agents, finishing agents for the production of permanent finishes and auxiliaries for the after-treatment of dyeings with substantive dyes. Products have been described in which both the anion and cation have active fatty components, an example being dodecylpyridinium laurate; these are devoid of detergent power.

The substantivity of textile assistants has been measured by Mecheels[20] at various temperatures up to 100°. The influence of pH and other factors was studied, but no attempt was made to approach the problem from the point of view of the constitution of the reagents or of wetting and detergent properties. Blow[21] has examined the substantivity of cationic soaps (*e.g.*, cetyl pyridinium bromide) towards wool. The adsorption rose with the pH and temperature; chlorination, followed by mild oxidation with hydrogen peroxide, accelerated adsorption and apparently modified the orientation of the cation, which was possibly attached to the wool surface by its hydrophilic head. Friedrich[22] has shown that highly sulphonated oils exhibit substantivity to wool due to affinity for the basic radicals of the latter; the property was of practical importance since the more or less permanent incorporation of the fat improved the feel, softness, fullness and mechanical properties of the fibre. It should be assumed that only comparatively loose adsorption compounds are formed, as the adsorption varied with temperature, pH, etc. Chemical combination of the fibre, such as the combination of cellulose with organic ammonium halides to produce permanent finishes, cannot be included in a consideration of the substantivity of textile assistants towards fibres.

Apart from the fact that detergents are

usually emulsifying agents, Hartley[23] has demonstrated the solvent action of soaps and synthetic detergents on organic substances sparingly soluble in water. Hartley pictures such solubility as being due to the paraffin-chain ions collecting together in fairly large aggregates or micelles (of the order of 50 ions in each); when the paraffin-chain contains 16 carbon atoms (the commonest number in detergents) most of the paraffin-chain ions are contained in these micelles except at great dilutions in which the micelles break down. The grease, oil or other organic substance forms a liquid solution in the micelles. Although it may have no obvious bearing on detergency, Hartley's work on the solvent action of soap and detergents has great significance with regard to the after-treatment of azoic dyeings with soap or synthetic detergent solutions.[24] Experiments have been in progress in this laboratory on the type of auxiliary agent with reference to chemical constitution and properties, such as wetting, emulsification and protective colloidal action, suitable for a given azoic combination to produce the maximum fastness to rubbing. The after-treatment is usually regarded as a process of removal by emulsification of the superficially precipitated azoic pigment formed from that part of the Naphtol not substantively adsorbed and not removed by hydroextraction; a process of solubilisation must now be assumed to be at least partially responsible for the action. So far as the solubility factor in detergency is concerned, the main constitutional characteristic of a detergent is a hydrocarbon chain of a minimum length. The presence of long chain fatty residues would appear to be essential in an organic detergent, as distinct from a wetting agent; where aromatic ring systems are introduced into the molecule, this is more or less incidental and is based on the availability and cheapness of a raw material, such as a dyestuff intermediate, rather than any vital influence of the aromatic ring on the efficiency of the product as a detergent. It would be noticed in numerous patents taken out in recent years for the preparation of detergents from aromatic amines, phenols, etc., that the introduction of an alkyl group of 6 or more carbon atoms is a necessary part of the synthetic scheme; higher alkylated anilines may be rendered water soluble by the usual methods (sulphonation, condensation with ethylene oxide and then with chloracetic acid, etc.) (*cf. Brit. Pat.* 475,867), leading to products with detergent properties. Even in the case of derivatives of the cycloparaffins, attachment of an alkyl chain is usual. *m*-Laurylamidocyclohexanyl sulphate and other derivatives of cyclohexanol containing an NH_2, SH or a second OH group have been suggested (*Fr. Pat.* 811,478). Hydroaromatic alcohols are condensed with olefines, or alternatively alkylphenols are hydrogenated, and then sulphonated (*Brit. Pat.* 464,491).

One view regarding the importance of protective colloidal power, the third of the postulated requisites for detergent action, has been quoted.[6] The disparity of outlook that is possible in this matter is indicated by the absence of any reference to it in a series of papers on "Wetting and Detergency".[2] In the practical aspects of detergency it may be taken to be an effective factor. The "Congo Rubine Numbers" of chemically pure samples of five commercial products, B (a recently introduced auxiliary agent free from natural fatty residues and from carboxyl and sulphonic groups), Y (sodium salt of oleyl N-methyltaurine), V (sodium lauryl sulphate), G (sodium β-oleyloxyethylsulphonate) and X (sodium di*iso*propylnaphthalene sulphonate), were 0·3, 0·7, 3·2, 4·0 and 4·5 (in c.c. of 0·5% solution); the relative efficiency, decreasing in the order named, was at least in qualitative agreement with their detergent efficiency in the kier boiling of cotton and, incidentally, their utility in the after-treatment of azoic dyeings. Two of the structural features of organic compounds exhibiting this property were high molecular weight and a balance of hydrophobic and hydrophilic components. Synthetical experiments[14] on fatty acid condensation products of arylamine sulphonic acids pointed to certain broad considerations in the chemical constitution of a good protective agent. Increasing molecular weight generally led to increasing protective action. Unsaturation in the fatty acid chain was a favourable factor, the oleyl derivatives being better than the saturated analogues, and the linoleyl derivatives better than the former; the apparently contrary effect of further increase in unsaturation needs to be confirmed by replacing the mixed fatty acids of linseed oil with pure linolenic acid. The free hydroxyl in ricinoleic acid exerted a favourable influence, the condensation products of ricinoleic acid with

sulphanilic, N-methylsulphanilic and naphthionic acids being the best protective agents in the series examined.

The chemical constitution of detergents may now be reduced to its essentials; a chemical classification of the closely related group of wetting agents has been attempted elsewhere.[2,5,14] As polar compounds of more or less complex character they have a hydrophobic and a hydrophilic half. The hydrophilic or water-solubilising group or groups may be carried at convenient points in the hydrocarbon residue. The hydrophobic half is usually an aliphatic chain, but it may be aromatic, hydroaromatic or alicyclic. The aliphatic chain may be saturated or unsaturated, straight or branched. The effect of the double bond would be to reduce the hydrophobic character of the molecule and increase solubility in water. The effect of unsaturation on detergency is shown by the superiority of sodium oleyl sulphate to sodium lauryl sulphate, although the latter is the better wetting agent. It has been stated, however, that at moderate temperatures sodium lauryl, oleyl and cetyl sulphates all show about the same detergent power.[25] Sodium ricinoleate is a better detergent than the oleate, but if a second hydroxyl is introduced as in dihydroxystearic acid, the detergency is decreased. The orientation of the molecule at the interface would be affected by the additional hydroxyl, tending to bend the chain towards the aqueous layer and having an unfavourable influence on the ability of the hydrophobic half to penetrate into the oily film.[26]

In the original detergents, the soaps, the hydrophilic carboxyl group was at the end of a straight chain of carbon atoms; in the simplest modification of the carboxyl, in order to obviate the sensitiveness to acids, alkaline earth salts, etc., the carboxyl was replaced by a primary alcoholic group, which was sulphonated or sulphated, the water-solubilising polar group being still at the end of the hydrocarbon chain.

Wilkes and Wickert[27] have divided surface-active compounds into 2 groups: in (1), of which the soaps, the fatty alcohol sulphates and the Igepons are examples, the polar group is a primary one, located at the end of the non-polar portion of the molecule; in (2), of which the Tergitols[27] (secondary alkyl sulphates), the Aerosols (esters of sulphosuccinic acid) and the Nekals are examples, the polar group is in a secondary position, the hydrophobic chain extending from it in two directions. The inclusion of the Igepons in (1) is of doubtful advantage, since the water-solubilising group is not present at the end of an unbroken chain of carbon atoms, but of one interrupted by a hydrophilic group. Wilkes and Wickert found that products of the first group were better detergents, but were inferior to the second group with regard to wetting power. While the first part of the conclusion is justified, it has not been possible to confirm the latter in its entirety. Examined by the interfacial tension or Herbig number methods, the secondary alkyl sulphates were not better wetting agents than the primary alkyl sulphates and Igepon T; but under prescribed conditions a recently marketed substance, having the structure of a dioctyl ester of sulphosuccinic acid, was found to give the highest Herbig number among the available wetting agents. The superior detergent power of compounds carrying the polar group at the end of the straight non-polar chain might be related to the facile adsorption of the linear chains on the cellulose macro-molecule, *i.e.*, to some factor of substantivity. At the same time, as a result of the varied and sometimes mutually opposed considerations involved in wetting and detergency, lengthening of the linear chain in order to obtain a certain favourable physical character of the aqueous solution might lead to lowering of the surface activity of the reagent on account of the tendency of the hydrocarbon residues to associate.[28] Branched chain derivatives might, therefore, have their points, as witnessed by the many patents covering possibilities in this direction. The secondary alkyl sulphates have been mentioned.

The acid sulphate ester obtained by the low temperature sulphation of 2-butyl-1-octanol has been claimed to be a good detergent (*U.S. Pat.* 2,077,005). Branched chain olefines containing at least 8 carbon atoms and one double linkage at the end of the chain are sulphonated (*U.S. Pat.* 2,061,617). Sulphation of tertiary alcohols, prepared by the interaction of vegetable oils with Grignard compounds, has been covered (*U.S. Pat.* 2,084,253). Triphenylmethane derivatives (*e.g.*, the condensation product of 2 mols. of 2-chloro-4-amylphenol with 1 mol. of benzaldehyde-2-sulphonic acid) have high capillary activity in acid, neutral and alkaline solutions (*Fr. Pat.* 816,959).

The hydrocarbon chain may be interrupted or bridged by hydrophilic groups, leading to a better balanced detergent molecule. Unsaturation, signifying unshared electrons, is hydrophilic in character. The usual hydrophilic centres in a wetting agent or detergent are derived from atoms and groups exhibiting co-ordinate covalency—nitrogen, phosphorus, sulphur, oxygen, and their combinations. Examples of subsidiary hydrophilic elements and groups utilised for bridging two hydrocarbon residues (one of which may be aromatic or alicyclic) are -O-, -S-, -SO-, -SO_2-, -CO-, -CO-O, -NH-, and -CO-NH-, the last, for reasons of its influence in favouring adsorption of the molecule by cellulose, being the commonest. Thus, sulphonated mixed ketones, R-CO-R′, in which R is an aryl or heterocyclic radical and R′ is an alkyl radical containing at least 6 carbon atoms, are detergents resistant to hard water (*U.S. Pat.* 2,089,154). Mixtures of aliphatic ketones and aromatic hydrocarbons are sulphonated to yield detergents (*U.S. Pat.* 2,081,795). Many of the synthetic possibilities in this regard have been covered by a wide patent of the I. G. (*Brit. Pat.* 479,835; 479,897) in which the products have the general formula $(A)_n$ X.B.C-, where $(A)_n$ stands for alkyl groups substituting X, an aromatic or cycloaliphatic group, B is an interrupting group (O, NH, S, etc.), and C a short alkyl chain.[28]

The most frequently employed ionogenic hydrophilic part of detergents is the sulphonic or sulphuric group. The earlier view of the undesirable nature of the carboxyl group has undergone a change[29] and among the commercial wetting agents and detergents are several containing both carboxyl and sulphonic or sulphato groups. Modification of the carboxyl by esterification or amidation using alkyl or arylamines results in a lengthening of the chain, which may be one reason for the improved wetting and detergent properties. Next in importance to sulphonate and sulphate groups as water-solubilising groups are thiosulphate, phosphate, pyrophosphate and borate groups, which are still more or less restricted to the patent literature.

Modification of the carboxyl and solubilisation of the fatty acid derivative without the introduction of strongly ionising groups, such as sulphonic and sulphuric, may be effected by the multiplication of hydroxyls; thus the partial esterification of pentaglycerol with coconut oil fatty acids yields a good detergent resistant to hard water (*Brit. Pat.* 439,435; 442,950).

Reference has been made to the recently marketed Igepals, which have excellent stability and detergent properties, and which contain no carboxyl, sulphonic or other ionogenic groups. They are soluble in water by virtue of other modifications in the aliphatic residues, and are highly polymerised compounds synthesised by systematic building up from low molecular units.

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Luminescence

VOLUME XXXV, Part I (January 1939) of the *Transactions of the Faraday Society* contains, for the most part, the proceedings of a general discussion on *Luminescence*, held under the auspices of the Society in September 1938. The subject includes all forms of emission of light by matter either on irradiation with ultra-violet or visible light, or on bombardment with X-rays or cathode rays or accompanying chemical or biochemical reactions. Altogether 28 papers bearing on different aspects of the problem and running over 238 pages are presented and discussed. The symposium has provided a forum for review and discussion of the theoretical and experimental advances made so far in this important branch of spectroscopy and the published proceedings furnish an authoritative and comprehensive reference number, especially as the list of contributors contains names of scientists who have made the subject what it is to-day. The discussion has been divided into three groups, namely, (1) luminescence of liquids and vapours; (2) luminescence of solids; and (3) chemiluminescence.

Luminescence of Liquids and Vapours

Absorption of light by matter leads, in general, to excitation of electrons associated with individual atoms or groups of atoms or radicals, to higher states of energy. This excess electronic energy may be converted to thermal or other forms of energy due to collisions of second kind, or be emitted in the form of energy of *luminescence*. When the emission of light takes place during the period of excitation the phenomenon is termed *fluorescence* and the emission after the exciting source is cut off is termed *phosphorescence*. Both fluorescence and phosphorescence co-exist and are difficult to separate spectroscopically except at very low temperatures. The simplest type of fluorescence which is easy of interpretation is the resonance radiation of mono-atomic gases and vapours. The *fluorescence-efficiency* expressed by the ratio of number of light quanta emitted to that absorbed is great in the case of these gases, provided the vapour pressure is small. The increase of pressure or the introduction of foreign gases results in mutual collisions between the excited atoms and their neighbours, which leads to *quenching* of fluorescence due to loss of energy as chemical or thermal effects. Two papers were presented on the photo-luminescence of gases by R. G. W. Norrish, and by Terenin, Vartanian and Neporent, both of which are concerned with the low fluorescence efficiency of polyatomic molecules. In these cases, due to interaction between the vibrational and rotational degrees of freedom with electronic transition, the fluorescence has a banded structure. The diffuseness in certain parts of the spectra and the total disappearance in others have been generally attributed to pre-dissociation; but Norrish points out that these effects may also be due to internal quenching of fluorescence by the internal vibrations of associated groups.

When we pass on to condensed systems, the fluorescence is no longer a rule as in gases but a rare exception. In these cases, most of the absorbed energy is converted to heat or other forms of energy. The general problems relating to the fluorescence of solutions to which E. J. Bowen refers in his introductory paper, are the efficiency of emission, spectral distribution of energy and the depolarisation. Connected with fluorescence-efficiency is the quenching of fluorescence of foreign substances and by surroundings. This problem of quenching has attracted a good deal of attention. Bowen and Norton discuss the quenching of fluorescence in solutions of anthracene dissolved in a number of solvents, at different concentrations and temperature and in the presence of various quenchers. Peter Pringsheim examines some of the explanations offered for the cause of the variation in fluorescence intensity in dye-stuffs and aromatic compounds and deals in particular with the quenching due to increase of concentration. This "concentration quenching" is explained as due to (1) collisions of second kind resulting in loss of absorbed energy as heat, and (2) the formation of non-fluorescing associated molecules. Due to its importance in sensitisation of photographic plates, the paper by Joseph Weiss on *Photosensitised Reactions and the Quenching of Fluorescence in Solution* is of great interest. The discussion following the papers leaves one the impression that the mechanism of quenching of fluorescence in liquids and solutions is far from being fully understood.

Polarisation measurements of fluorescent light in liquids and solids furnish important data leading to conclusions as to the orientation of oscillators responsible for the emission of light with respect to the length of the exciting molecule. The only paper dealing with this question is on the *Polarisation of Fluorescence of Dye-stuffs Dissolved in Meso-phases* by Zocher.

Luminescence of Solids

The scientific and commercial application of the luminescence of solids has, in recent years, given a new impetus to theoretical and experimental studies in the subject. From the theoretical point of view, luminescence in solids has been discussed briefly in an introductory paper by F. H. Spedding and in greater detail by Gurney and Mott, Frederic Seitz, C. J. Milner and N. Riehl. Two distinct types of luminescence in solids exist, namely, of pure solids and of those activated by impurities. But essentially, the fluorescence and phosphorescence in solids are associated with non-ideal crystal lattice, resulting from imperfections or distortions in the lattice brought about by heating or pressure or by the introduction of foreign impurities. Experimental evidence seems to show that the impurity atoms are distributed throughout the bulk of the parent substance. The part played by the imperfections of the lattice on the one hand, and the

impurity atoms on the other, in the re-emission of absorbed light is essentially the same. J. T. Randall has shown in his paper on *Some Recent Experiments in Luminescence* that many inorganic solids in the pure state yield fluorescence spectra at very low temperatures. It is possible that in these cases 'interstitial' metal atoms in the lattice like Zn in ZnS_n, act as luminescent centres just as foreign impurities in ordinary *phosphors*. The questions that present themselves in the case of solids are, (1) what is the mechanism of absorption of energy, and (2) what is the process which results in the emission of light. Riehl believes that the energy is absorbed by the atoms of the bulk material as well as of the impurity and the absorbed energy in units called '*exciton*' wanders over without radiation to the few impurity atoms or '*activators*' and is then re-emitted. The modern theory of semi-conductors and insulators formulated by Brillouin, Wigner and Seitz offers a quantum-mechanical explanation for the process of light-emission by solids and its relation to photo-conductivity. According to this theory, the valence electrons of the component atoms in a crystalline solid exist in energy states associated with the lattice as a whole. The periodic potential field due to these electrons causes the possible transitions of electron energy to be restricted to certain bands or '*zones*' with '*forbidden regions*' lying between them. The function of the impurity atoms or imperfections in the lattice is to introduce additional energy levels in the forbidden region. The absorption of energy by an electron of the lower level leads it to go to a higher level leaving a '*hole*' behind. The excited electron may lose its excess energy as heat radiations without exhibiting any luminiscence or fall back to any of the lower states (stable or meta-stable), but not necessarily to the hole which it left behind, with the emission of radiation (luminescence). By a combination of Pauli Exclusion Principle and Frank-Condon curves, Milner gives a theoretical interpretation of the observed facts about sulphide phosphors and Seitz explains the characteristics of the alkali-halide-thallium phosphors and zinc sulphide phosphors which exhibit photo-conductivity. But the theory is by no means able to explain all the observed facts satisfactorily. Experimental observations which would be helpful for formulating a theory of sulphide phosphors are given by Levy and West in their paper. Expressions for quantum-efficiency of luminescence in solids and the laws of decay of phosphorescence in mono-molecular and bi-molecular reactions are given by Gurney and Mott. Influence of crystallisation upon the intensity and duration of luminescence in certain glasses is dealt with by Maurice Curie and a useful review of the experimental results with luminescence of inorganic solids is given by J. Ewles.

As shown by Spedding in his introductory paper, luminescence of solids yields two classes of spectra, (1) the *continuous* spectra and (2) the discrete or *line* spectra. In the light of the theory given above, if the energy states of the valence electrons are broad, either due to the influence of the neighbouring atoms or due to the thermal agitation of atoms (Debye waves) or the lattice oscillations, the spectra are continuous. Discrete spectra are given when the upper and the lower states are sharp. This condition is secured, among others, in crystals containing the elements of the transition groups and divalent manganese and trivalent chromium ions and in organic compounds containing unsaturated resonating bonds. Lowering temperature simplifies the spectra in all cases and renders the continuous spectra generally sharp. From the papers presented and the discussions, it is clear that there is much scope for further experimental work by employing low temperatures and single crystals. The influence of lattice oscillations and molecular vibrations and rotations on the position and distribution of intensity in the spectra remains to be worked out.

In a very interesting paper on the *Application of Phosphorescence Spectra to the Investigation of the Structure of Solids and Solutions*, R. Tomaschek outlines a new method of investigation of (1) the structure of glasses, (2) the nature of phosphorescent centres, (3) the hyperstructure of crystals and (4) the constitution of liquid solutions. The method consists in embedding ions of Cr, Ni, or Co or the rare earths in solids which otherwise yield continuous spectra and in analysing the resulting line spectra in terms of the energy scheme for the activator. Further development of the method promises to yield valuable information regarding the nature of forces in the solid and the liquid media. The technical importance of investigations in luminescence in solids is shown by papers dealing with fluorescence efficiency of discharge tubes containing neon by Jenkins and Bowtell, with cando-luminescence by Minchin and with the practical application of luminiscent solids for the manufacture of high lumen-efficiency mercury discharge lamps and of decorative signs and for the preparation of luminescent screens for television by T. J. Davies. Developments of commercial value in illumination engineering may be expected to arise out of researches in this direction in the near future.

Chemi-Luminescence

As in the luminescence of solids and liquids, the emission of light accompanying certain chemical reactions is explained as due to the production of excited ions, ionic complexes, or radicals during intermediate reactions, and consequent emission of photons. The explanation of different stages of chemical reactions involved varies from system to system and in fact, the spectral study of the emitted light yields important information regarding the kinetics of those reactions. The papers, dealing as they do with individual systems, are necessarily incoherent and cannot be brought under one common principle. The paper by R. Audubert contains interesting new observations on the *Emission of Ultraviolet Rays by Chemical Reactions*, which would be of help in future investigations of molecular transformations during chemical changes. The paper on Bioluminescence by Harvey gives a brief review of the theories advanced in explaining the

mechanism of production of light of high quantum efficiency by living matter.

In conclusion it may be stated that the contributions made in the Symposium and the lively discussions accompanying them show that while luminescence is a fundamental phenomenon and much has been done in the way of exploration, there is much more which awaits further investigation, both theoretically and experimentally, before a general theory of luminescence explaining all facts connected therewith could be formulated. By bringing together prominent workers in the field and publishing the proceedings in full, the Faraday Society has done a great service for the future workers in the subject.

C. S. VENKATESWARAN.

Einstein's Generalisation of Kaluza's Unitary Theory

THE Kaluza-Klein theory introduces a fifth dimension in attempting to derive a unitary theory connecting gravitation and electricity. Einstein has recently attempted to generalise this theory[1] by putting in physical concepts into the purely mathematical structure of Kaluza's theory.

The aim of this theory of Kaluza was to obtain some new physical aspect for gravitation and electricity by introducing a unitary field structure with the aid of a fifth dimension, the essential result being that such a five-dimensional structure could be built up so as to be equivalent to a four-dimensional structure *plus* a vector field which is the potential vector for the electro-magnetic field. This result, though elegant mathematically, was not productive of new physical ideas, and consequently many attempts were made to retain the essential formal results obtained by Kaluza without sacrificing the four-dimensional character of the physical space. But all such attempts have proved unproductive, and it appears impossible to formulate Kaluza's idea in a simple way without introducing the fifth dimension.

On the basis of these considerations, Einstein and Bergmann have now attempted to introduce the fifth dimension in a very effective manner without its being merely a sort of "catalytic agent" as in the Kaluza theory. To bring out clearly the generalisation proposed by Einstein, let us consider how Kaluza's five-dimensional structure is made equivalent to a four-dimensional one and a vector field. It can be shown that by a suitable characterisation of the 5-space with the metric

$$d\sigma^2 = \gamma_{\mu\nu}\, dx^\mu\, dx^\nu \quad (\mu, \nu = 0, 1, 2, 3, 4) \ldots (1)$$

the components of the fundamental metric tensor can, by the choice of a special co-ordinate system, be reduced to ten functions g_{mn} and the four functions A_m ($m, n = 1, 2, 3, 4$) *which do not depend on* x^0. This reduction gives a four-dimensional description of the space, and the independence of the functions on x^0 shows the purely formal nature of the fifth dimension x^0 which is just put in only to be taken out later. On Einstein's new theory it is shown that, with a suitable modification of the postulates of the 5-space, it is possible to make an exactly analogous reduction to g_{mn} and A_m with this difference that the *components of* g_{mn} *are in general periodic functions of* x^0. The A_m, however, is independent of x^0 as in the old theory. Remembering that g_{mn} is a four-dimensional metric tensor, this amounts to an intimate physical connection of the space-time with the new dimension. The x^0 which is put in at first is not taken out after the reduction but left behind so as to modify the 4-metric. The periodicity of the components of this 4-tensor in the new co-ordinate enables one to interpret physically the fifth dimension. In a very rough way, one could describe this as a sort of a *phase*, and the 4-*dimensional space-time* might be thought of as having been replaced by a 5-*dimensional space-time-phase*. Since, however, this new co-ordinate is "dimensionless" there arises no contradiction with the empirical four-dimensional character of physical space.

From its very nature, the new theory is essentially complex in its physical aspects, and Einstein and Bergmann have given the derivation of the fourteen field equations starting from a variational principle, and also the identities satisfied by the field equations. The theory involves four universal constants of which one corresponds to the gravitational constant involving a connection between the units of length and mass, another depending on the unit of length, while the remaining two are "genuine" universal constants which cannot be eliminated from the theory.

When looked at from the purely geometrical point of view the new theory introduces some very interesting features. The five-dimensional space defined by the metric (1) is here closed with respect to one dimension, and this closed space will be represented by a space which is open and periodic with respect to this dimension. A point P of the physical space will be represented by an infinite number of points P, P′, P″ of the 5-space. This type of non-homeomorphic correspondence between general metric spaces is itself a rich mathematical concept capable of a large number of developments.

B. S. MADHAVA RAO.

[1] Vide *Annals of Mathematics*, July 1938, **39**, No. 3, 683.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(University Librarian, Madras)

Dale, Samuel (1659–1739)

SAMUEL DALE, a British botanist and physician, was apprenticed for eight years to an apothecary, and he established independent practice, about 1688. His critical knowledge of plants and drugs was acknowledged by eminent scientists of his day.

Contributions to Medicine

His chief work was the *Pharmacologia or an introduction to the materia medica* (1693) which went through several editions even long after Dale's death. It was the first systematic work of importance on the subject.

Contributions to National Science

His second great work took the form of an appendix to the second edition (1730) of Silas Taylor's *History and antiquities of Harwich and Dovencourt*. He built up a herbarium of great value. He bequeathed this to the Apothecaries' Company and it is still preserved in the British Museum.

Genus *Dalea*

Nine of his papers were published in the *Philosophical transactions* of the Royal Society. His services to Botany made Linnaeus immortalise his name in the leguminous *Dalea*.

Dale died June 6, 1739.

Cunningham, Allen (1791–1839)

ALLEN CUNNINGHAM, an Australian botanist, was born at Wimbledon, Surrey, on July 13, 1791. He was educated at Putney and trained for the law by a Lincoln's Inn conveyancer. Finding these studies uncongenial, he became assistant to Acton, the manager of Kew Gardens. In 1814 he was appointed Botanical Collector to the Royal Gardens. Having spent two years in Brazil, he reached New South Wales in 1816. He spent the next sixteen years in explorations and botanical researches, having been attached to P. P. King's survey party from 1817 to 1822.

His Publications

His notes on the botanical results of the survey occupy nearly 40 pages of King's *Narrative of a survey*. It was considered important enough to be issued separately in German as *Einige allgemeine Bemurkgen uber die Vegetation, vorzuglich der Nordwestkuste von Australien* (1829). Six other papers of Cunningham were published in different periodicals.

As Colonial Botanist

Having spent about four years in England to arrange and name his specimens at Kew, he succeeded his brother in 1835 as Colonial Botanist; but he resigned in 1837 as he found that his duties included too much uncongenial work and actual gardening, the government officials having formed the habit of procuring their supply of vegetables from the botanical garden. But the Governor was anxious to retain his services and ordered the abolition of the "Cabbage Garden" practice. But Cunningham demanded the position of government botanist, with no responsibility for the botanical gardens and *carte blanche* as to the disposal of his time. As it was felt that the last condition might prove a dangerous precedent, he was offered as an alternative, six months' leave every year to prosecute explorations. But the negotiations fell through and Cunningham went away to botanise in New Zealand, from where he returned to Sydney in a deplorable state of health and died, June 27, 1839.

Bell, Horace (1839–1903)

HORACE BELL, a British Indian engineer, was born in London, June 17, 1839. Having received his early education in France and at Louth in Lincolnshire, at the age fifteen, he was placed as a pupil with a civil engineer in Westminster. But recognising, even at that age, the need of thorough grounding in the profession he wished to follow, he went to Glasgow where he entered the firm of Messrs. D. Cook & Co., as an apprentice. Afterwards he worked in Caledonian Railway shops. In 1859 he got employed in London. Three years later, he was successful in open competition for an appointment as an assistant engineer in the Indian Public Works Department.

As Indian Engineer

He was posted, in the first instance, to the Central Provinces, where he worked on the construction of the Grant Deccan Road connecting Calcutta and Bombay. In 1870 he was sent on railway survey work to the Wardha valley and successively worked in the construction of several railways such as Indore (1870), Punjab Northern (1874), Rajputana (1875), Neemuch (1878), Great Western and the Moghul-Serai Railways.

Nilgiri Mountain Railway

On retirement, he established himself as a consulting engineer in London and as such, he guided the design and construction of the Nilgiri Mountain Railway, a rack railway of meter gauge, opened in 1899.

Bell died in London, April 10, 1903.

ASTRONOMICAL NOTES

Planets during July 1939.—Mercury will be an evening star and on July 14, will be at its greatest eastern elongation from the Sun (— 26° 31'). Venus continues to draw closer to the Sun and will be visible only for a very short time before sunrise. Mars is best situated for observation, being in opposition to the Sun on July 23; its semi-diameter at the time will be 24″ and the stellar magnitude — 2·6 (nearly two and a half times brighter than Sirius). The planet is closest to the earth on July 28 when the distance will be about 36 million miles.

Jupiter rises a little before midnight and will be a conspicuous object in the eastern sky during the latter part of the night. On July 30, it will be at a stationary point of its apparent orbit. Saturn will be in quadrature with the Sun on July 24 and will be found near the meridian at sunrise. The ring ellipse is getting gradually wider, the major and minor axes being 40″ and 11″ respectively on July 15. Uranus is slowly moving eastwards in the constellation Aries and can be seen as a morning star. There will be a close conjunction of the planet with the Moon on July 12. An occultation of some interest that can be observed in India is that of α Libræ (magnitude 2·9) by the Moon on the night of July 24.

Comets.—Pons Winnecke Comet is still faint and is moving towards the south in the constellation Böötes. According to the computations of Levin and Porter, the Comet will be nearest the earth on July 2 when the distance will be about ten million miles. At the apparition of 1927, the Comet approached the earth to a distance of four million miles when it was conspicuously visible to the naked eye. Although it may not reach the same brightness next month, it is very likely the Comet will become bright enough to be seen with some moderate optical aid.

The bright Comet (1939 *d*) which was discovered on April 18, was visible to the naked eye for a considerable time and has been widely observed. It has since moved southwards into the constellation Canis Minor and has become fainter. T. P. B.

SCIENCE NOTES AND NEWS

A New Method of Creating Electrification.—When certain insulating materials, *e.g.*, silica, sulphur, in an adequate degree of fineness are allowed to strike a metal plate perforated with small holes, the metal plate becomes electrified positively and the insulating powder negatively. In order to produce the effect the materials must be dry and the size of the grains of the powder must be such that when they fall on the perforated metal sheet, they fall through and do not accumulate on the metal. This novel phenomenon recently discovered by A. Flemming (*Proc. Phys. Soc.*, 1939, 51, 401) is shown to be inexplicable in terms of frictional or piezo-electric effects, and forms the starting point of a new and fruitful line of investigation. K. S. G. D.

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Bud Mutations in the Orange.—An extraordinarily interesting instance of bud mutation is to be found in the case of the Satsuma Orange (Unshiu), *Citrus unshiu*, Marc. var. *præcox* of the variety called Wase. This variety has the peculiar characteristic that it does not breed true from vegetative propagation. These trees often send out single branches of entirely different character from the main type of branches on the tree. In some trees the variation branch is not limited to a single branch per tree but that two or even three arise from a single tree. These bud mutations show the most diverse variations. Some are suited to hot climates; some are resistant to insufficient care; some produce gigantic fruits; some give fruits which are globose, and others flat-topped fruits; some again are found to suit even very cold climates; some give exceedingly early-maturing fruits of excellent quality. It is stated that quite fifty different mutants have been so far observed in this variety of orange. The discovery of this phenomenon has been fully exploited by the Japanese in extending their areas of orange cultivation and in raising fruit which can come into the American market long before the local crop. Prof. Tanaka, the famous authority on oranges, who draws attention to this interesting subject (*The Philippine Agriculturist*, 27, No. 6) refers to the great difficulty of explaining scientifically this problem of the unstability of the Wase variety of the Satsuma Orange and after discussing various possibilities, inclines to the opinion that the change may be the result of external factors like a strong stimulus, as a wound or a break, or unusual accumulation of nutrients by girdling or twisting. He states his observation that the mutating branches have distinct signs of disturbance close to the point from which the mutation started. If this view is correct, then it should be very easy to induce mutations artificially wherever desired. A. K. Y.

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The Effect of Scion on Stock.—Describing the progress of horticultural research in Japan, Prof. Tanaka draws attention to what is well known to Japanese pomologists, though not so well known outside, *viz.*, the marked change undergone by the citrus stock *Poncirus trifoliata*, the trifoliate orange, which is the stock used extensively in Japan for the propagation of the orange (*The Philippine Agriculturist*, 27, No. 6). The trifolate orange plant

is a shrub in nature but when it is used as a rootstock it swells up greatly in size, becoming thicker than the scion when the latter assumes an enormous size. Prof. Tanaka studied the results of budding citrus varieties of many kinds on to trifoliate rootstock and found that the rootstock undergoes remarkable change, showing a different amount of growth exactly in accordance with the scion species. With scion of sweet orange, for instance, the trifoliate stock becomes deep-rooted; with the lemon as scion, the opposite effect is produced on the trifoliate rootstock, *viz.*, a shallow root system, and even a change in the colour of the roots. The same result of changing the character of the root system of the stock has been found, he says, in the Japanese *Persimmon Diospyros* Kaki, and in other fruits. Some varieties always give the roots a narrow angle or a deep-rooting habit to the rootstock while others give a shallow-rooting habit. In the case of the apple, the *Famuse* apple in California is stated to give a deep-rooting habit and the *Akin* apple a shallow-rooting habit to the rootstock.

A. K. Y.

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The Absorption of Ammonium Nitrogen by Plants.—That pineapple plants can absorb and assimilate ammonium nitrogen and that they can do so more readily than nitrate nitrogen when grown in nutrient solutions, is shown by water culture experiments, reported by C. P. Sideris *et al* (*Plant Physiology*, 1938, 13). The immediate products of the assimilation by the roots were amino-acids and small quantities of glutamine and asparagine. Nitrate was assimilated very slowly if at all in the root tissues and was translocated through the stem and non-chlorophyllous tissues of the leaf bases presumably to the chlorophyllous tissues. Nitrate nitrogen was neither absorbed nor assimilated as readily as ammonium nitrogen, which was apparently assimilated in the roots as readily as absorbed. Plants in the ammonium series contained in the non-chlorophyllous tissues comparatively great amounts of soluble organic nitrogen and small quantities of protein; whereas the plants in the nitrate group had in their roots large quantities of protein as compared with organic soluble organic nitrogen. The nitrate group also showed a lower rate of carbohydrate utilisation as evidenced by the presence in their leaves of somewhat greater amounts of reducing sugars and sucrose.

A. K. Y.

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The Golgi Apparatus in Amphibian Tissue Cells.— An important contribution to our knowledge of the structure of the Golgi apparatus of vertebrates is made by A. W. Pollister (*Quart. Journ. Micros. Sci.*, March 1939, 81, Pt. II). He has examined practically every tissue cell of Amphibia and is able to formulate certain general conclusions regarding the structure and arrangement of the Golgi apparatus in this group. Larvæ as well as adults have been examined. Regarding the arrangement of the Golgi apparatus and the associated parts in the cell he notes two types: (1) the epithelial or physiologically polarised type where the Golgi apparatus is in the form of a collar surrounding the nucleus and with the centrioles far distant from the Golgi apparatus; (2) the leucocyte or physiologically the unpolarised type where the Golgi apparatus is in the form of a horizontal collar in close relationship with the centrioles. Regarding the structure, two facts appear to be emphasised by the author: (1) Everywhere and in every kind of tissue cell of Amphibia the Golgi apparatus is lamellar and presents some variation of a plate-like structure resembling the condition found among the invertebrata; (2) In the Amphibia, at any rate, no differentiation between osmiophilic and osmiophobic regions can be made out in the Golgi apparatus.

* * *

A Gigantic Monument in India.—A new chapter has been added to the artistic and cultural history of Bengal in the publication, just made, in the series of *Memoirs of the Archæological Survey of India*, of a monograph on the results of the excavations at Paharpur, Bengal.

The Paharpur mound and its enclosure were protected by the Archæological Department nearly twenty years ago, and the first sod was turned sixteen years ago. The systematic excavation by the Archæological Department begun in 1925 was only recently concluded, and the place has now revealed a great four-storeyed temple with a unique plan and a gigantic monastery containing nearly 190 cells enclosing it.

The plan of the main temple at Paharpur consisting, as it does, of a square shrine in the centre with cross-shaped adjuncts on each side and projections between each side, the whole being constructed in four terraces, is so far unique in India and supplies the missing clue to the type of architecture so prevalent in Burma, Java and the Malayan Archipelago. After the discovery of Paharpur an earlier prototype has been found farther inland at Nandangarh in the extreme north of Bihar.

The most important discoveries at Paharpur are the stone images in the lower basement of the main temple, which revealed a new school of art in the sixth–seventh century A.D. It is astonishing that in a monument which, there is no doubt, must be identified as the Buddhist *vihara* built by the well-known Pala Emperor, Dharmapala, at the end of the eighth century A.D., such a remarkable series of sculptures consisting mainly of Brahmanical figures should have been found embedded in the walls in such good preservation.

The most numerous specimens of artistic work found at Paharpur are the terracotta plaques, of which nearly 2,800 were found, over two-thirds being still *in situ*. These plaques in which are depicted a bewildering variety of subjects play a prominent part in the scheme of decoration of the walls in each terrace of the temple, there being two or even three rows of plaques in some walls.

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The Bihar Earthquake of 1934.—Extensive investigations have recently been made on the nature of the numerous earth fissures which came into existence all over the affected area, as a result of the great Bihar earthquake of 1934. The fissures were widespread over certain zones north of the Ganges, and generally

followed pronounced surface features such as river-banks, lakes, tanks, road and railway embankments, etc. Sometimes they were arranged in a series of step faults, others resembled trough faults where the ground sank between two parallel fissures. The maximum width of a fissure was about 27 ft. and the greatest length, 700 yards. Towards the end of the main shock, and immediately after it, enormous quantities of sand and water were thrown out from vents and fissures. The fact that the erupted water was frequently reported to have been hot shows that it may have come from a fair depth.

The fearful rumblings which accompanied the earthquake have also been investigated and these have been variously described as comparable with the noise of "several aeroplanes", "a heavy motor lorry", "an approaching goods train", "a passing motor car", or "a train passing through a tunnel". So far as can be judged, these sounds were heard more or less simultaneously over the whole area, and could not accordingly have originated from a point. During the transmission of seismic waves, rock particles are moving rapidly against each other, and the secondary vibrations so set up may give rise to sound waves. The sounds emitted are independent of the speed of the seismic waves, but are indirectly dependent upon their frequency.

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Earthquake Shocks in 1938.—According to the General Report of the Geological Survey of India for 1938, Htawgaw, not far from the China frontier in the northern corner of Burma, maintained its notoriety as one of the most seismic places in this country, by recording several scores of shocks.

A series of tremors and shocks of varying intensity, accompanied by loud rumbling sounds, were felt in Western India at Paliyad. The shocks are ascribed to changes taking place beneath the Deccan trap formation of the locality, probably connected with the uplift of Kathiawar in recent geological times, which in places amounts to about 1,200 feet.

Occasional shocks of small intensity continued at Mettur in the Salem District where the Cauvery River has been impounded by a large dam having a miximum depth of storage of 165 feet and a net capacity of 93,500 million cubic feet of water.

Many shocks of light to moderate intensity were reported from north-western India, the Punjab, Kashmir, North-West Frontier Province and Baluchistan. One of these, of moderate intensity sufficient to affect persons at rest and make hanging objects swing was felt between 15·00 hours and 15·05 hours I.S.T. on January 18, 1938, over a large area north and west of Lahore. No damage to property was reported. Two other shocks of a similar nature, one at about 16·15 hours on January 26 and the other at about 1·00 hour on February 15, were also felt in several places in the North-West Frontier Province.

A number of tremors and light shocks were felt in Assam, in and around the plateau.

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Andamans' Shell Fishery.—Indications of a new industry, the possibilities of which yet remain to be exploited by India, are given by the Zoological Survey of India, as a result of investigations lately concluded on the shell fishery of the Andamans and Nicobar Islands.

Round these reef-bound islands of the Bay of Bengal, there occur beds of two large species of marine snails, the Top-Shell and the Turban-Shell of commerce known to zoologists as *Trochus niloticus* and *Turbo marmoratus*. The shells of the snails, as well as those of the pearl-oysters and similar animals, are largely used in China, Japan, the Philippines and other parts of the world for inlaying and other forms of ornamental work and in the manufacture of buttons, studs, tooth powder, etc. The best grades of shells are sold at Rs. 600 to Rs. 800 per ton in the Singapore shell market. Between 1930 and 1937, the shells fished under licence in the Andamans and Nicobar areas exceeded 1,200 tons, valued at Rs. 8,50,000.

Little was known of the occurrence, life-history, growth and bionomics of the shell fish, and as rules and regulations to control the fishery had to be based on facts relating to the life of the animal, the Zoological Survey of India was called upon to undertake a preliminary study of the fishery in 1930, when the fishing by enterprising Japanese Fishery Companies had been in progress for three months.

With the help of a small research staff at Port Blair, Andamans, drafted from the Zoological Survey of India and under the control and direction of the Director of the Survey, some important facts concerning the life-history of the shell fish and the fishery were gathered during the six years 1930–35. These facts are now published in the form of a "Consolidated Report on the Shell-fisheries in the Andamans".

As a commercial proposition, the shell-fishery has suffered a setback mainly as a result of excessive fishing in the earlier period, both by the licensed and the unlicensed Japanese fishermen of Singapore, which has considerably thinned out the shell population of the sea. The indiscriminate removal of all shells, whether young or in the breeding stage, has likewise been the cause of the decline of the shell population.

The enforcement of the observance of the rules and regulations framed for the protection of the fishery was by no means easy. The result has been that shell-fishery in the Andamans has been at a low ebb for the last five years and it seems that nothing can rehabilitate it except prolonged rest from fishing for a period from three to five years.

* * *

Dipterocarpus (Gurjan) Forests in India and their Regeneration.—A recent publication issued by the Forest Research Institute, Dehra Dun (*Indian Forest Records*, 3, No. 4) summarises all available information concerning the *Dipterocarpus*, which are extensively employed for railway sleepers, plywood and for general constructional purposes. Nine species of *Dipterocarpus* are known, all of which are considered to be good, general utility timbers. The trees are usually of large size and give a high outturn of sound, clean timber of uniform quality.

The publication, besides containing information on the distribution and silvicultural characters, gives details regarding the natural and artificial methods of regenerating these species.

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The Hornet's Nest placede on show in the Insect Gallery of the Indian Museum, Calcutta, is probably one of the largest specimens that have yet come to notice, it is a never-ending source of interest to the visiting public, who are able to examine at close quarters and in perfect safety its complicated internal structure.

The nest was acquired by the Zoological Survey of India from a small *bael* tree growing in the compound of a house in Calcutta in 1925. On enquiry it was found that the hornets commenced building this beautiful nest in the spring of 1924. In the month of March the size of the nest was about the size of the *bael* fruit and by May it had attained the size of a man's head; towards the end of October the growth of the nest reached its maximum and was over 3½ feet in height, its maximum breadth near the base being over 2 feet.

The nest is covered over by an envelope of a papery material which is probably a mixture of chewed wood and some glandular secretion of the hornets; usually the covering is thin and delicate but in the present case it is very strong and tough. The envelope completely encloses the nest, except for two small circular openings on the two sides near the base, which served as the ingress and exit passages to the nest.

Vespa cincta, which is the name by which this insect is known to the scientific world, is a fairly common species of hornet found all over the plains of India. It builds its nests in the holes of large fig and other forest trees. It is largely predacious and its larvæ are known to feed on other insects. Although at times it causes injury to fruits, it is useful as scavenger and in reducing the number of other insects, more especially Dipterous and Lepidopterous larvæ which are responsible for the destruction of several economically important plants.

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A new giant telescope has recently been installed at the **McDonald Observatory** in Davis Mountains of Western Texas. The instrument has a 82-inch mirror and is capable of photographing stars only a millionth as bright as any that can be seen by the unaided human eye. This brings the total number of telescopes of 2 feet in diameter or more now in use in the world to 40. According to a Bulletin recently issued by the *National Geographic Society*, "The McDonald Observatory telescope is the second largest in the world in actual use at present, being exceeded only by the 100-inch telescope at Mount Wilson Observatory, Pasadena, California. Both, however, will be surpassed soon by the 200-inch telescope to be set up on Mount Palomar, California, under the joint auspices of California Institute of Technology and Mount Wilson Observatory. The McDonald Observatory will be operated jointly by the Universities of Texas and Chicago. The mirror of the McDonald Observatory telescope weighs nearly three tons, yet its curved surface has been ground and polished to an accuracy of one-millionth of an inch. The telescope and its mounting weighs 75 tons, yet it is so perfectly balanced that it is moved by a motor of 1/3 H.P. and can be adjusted to a hair's breadth."

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Demographic Problems.—The League of Nations' Committee of Experts, whose terms of reference were "to study demographic problems and especially their connection with the economic, financial and social situation and to submit a report on the subject which may be of practical value to Governments in the determination of their policies", held its first session recently, with Prof. T. Smolenski as Chairman. According to a communique issued by the Information Section of the League of Nations, the Committee held a general discussion with the object of defining the points to which its studies should, in the first place, relate. The following three questions will receive attention at the beginning: (1) the problems which present themselves in countries with rapidly increasing populations; (2) the problems which present themselves in countries with or threatened with diminishing population and (3) the problems which present themselves in countries with a population which is small relatively to the productive area or to the natural resources. The Committee also considered the advisability of organising a demographic centre attached to the Secretariat.

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Anti-Malarial Drugs.—The enormous disproportion between the world output of quinine and the quantity required to treat known cases of malaria is widely recognised. The latest issue of the *Chronicle of the Health Organisation* of the League of Nations (Vol. I, No. 6) refers to this question and points out that "this matter is the more deserving of attention as malaria-ridden countries are usually countries of limited economic resources and are unable for that reason to meet the expense of collective treatment and prophylaxis by anti-malarial drugs".

The Malaria Commission has carried out extensive comparative experimental work on the so-called synthetic drugs. The research work conducted by the Commission has enabled it to recommend the use of *totaquina,* a mixture of cinchona bark alkaloids, that can be produced at a price well below that of quinine.

With a view to consider the present state of production of anti-malarial drugs in various countries, the requirements of malarious countries and future possibilities and to consider how the consumption of these drugs can be promoted, the Health Organisation of the League of Nations, on the recommendation of the Malarial Commission, proposes to call for a conference of representatives of producing and consuming countries; the conference will probably be held in 1940.

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Microbiology in the Preservation of the Hen's Egg.—When eggs are stored all possible steps must be taken to prevent their spoilage by moulds and bacteria. A recent report issued by the Food Investigation Board (*Special Report,* No. 47. H. M. Stationery Office. Price 2*sh.* 8*d.*) deals *inter alia,* with the various kinds

of micro-organisms that attack the egg, the sources from which they come, the types of spoilage they cause, the egg's defences against invasion, and the means that can be adopted in storing eggs to reduce infection and consequent spoilage.

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The **Simphak** or Bark cloth of the Garos of Assam, was one of the exhibits shown by Dr. B. S. Guha at the ordinary monthly meeting of the *Royal Asiatic Society of Bengal* held on the 5th June. "The making and use of bark cloth is confined to the Matchi and Chisak Garos inhabiting the eastern half of the district. They call it *Simphak* and prepare it from the bark of one of the following trees: (1) Pakram (*Grewia liliœ folia*), (2) Prap (*ficus Rumphi*), (3) Chram (*Artocarpus Chaplosha*), (4) Dumbri (*ficus glomorata*), (5) Anisep (*Kydia calycina*). Of these the first yields the best and the last, the worst kind of *Simphak*. The bark is taken from the main stem of the trees by cutting two rings on the stem about 8′ apart. These are joined by one vertical cut and the bark is split open and pulled off. The outer green layer is carefully removed and the bark is well pounded from the one end to the other running along the fibre with serrated mallet on a smooth log of wood. It is then doubled over lengthwise and the process of folding and pounding is continued until it is reduced to a thick mass of fibre. The moisture is wrung out and it is dried in the sun unfolded. The requisite length and width are obtained by stitching together two or three pieces, the usual size being $8' \times 2'$. The *Simphak* is used for blanket or bedding purposes and is never used for wearing by the Garos."

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The *Annual Report* of the **Indian Association for the Cultivation of Science** for the year 1938 refers, briefly, to the more important activities during the past year. Sir Arthur Hill delivered the Ripon Professorship lectures for 1938, Prof. J. E. Lennard Jones, the Coochbehar Professorship lectures, and Sir L. L. Fermor, the Ripon Professorship lectures for 1937. The Joy Kissen Mookherjee Gold Medals for the years 1937 and 1938 were awarded to Sir James Jeans and Dr. F. W. Aston. Seven scholarships were awarded during the year. Thirty-nine papers covering 462 pages were published in the *Indian Journal of Physics*, the contributions being drawn from various parts of the country. Important research work was carried out under the direction of Professor K. S. Krishnan, Mahendralal Sircar Professor of Physics; these researches are classified under the following heads: (1) Paramagnetic studies on single crystals at low temperatures, (2) Magnetic behaviour of manganous salts, (3) Magnetic anisotropy of hydrated gadolinium sulphate, (4) Magne-crystallic studies in relation to valency problems, (5) Crystalline fields in rare earth salts, (6) Magnetic studies in relation to crystal structure, (7) Some theoretical implications of the magne-crystallic work and (8) Magnetic studies on organic crystals. Dr. S. C. Deb, Research Fellow, carried out investigations on the absorption spectra of sulphides and sulphur molecule.

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The Mining, Geological and Metallurgical Institute of India.—The latest number of the *Transactions of the Mining, Geological and Metallurgical Institute of India* (May 1939, 35, Pt. 1) gives the Proceedings of the Annual General Meeting of the Institute held on 13th January 1939, at which Mr. A. Farquhar was elected President of the Institute for the ensuing year. Mr. Farquhar's Presidential Address deals with the factors governing the conservation of the natural mineral resources of the country—especially of the coking coals of India. He deals with the various aspects of this problem, such as stowing of coal by packing, co-ordinated sequence of working the coal seams, blending of coals, washing of coals, rationalisation of coal production and coal consumption, research, etc., and in this connection, discusses the several recommendations of the Coal Mining Committee. In Mr. Farquhar's opinion, "the most pressing need to-day, therefore, is the formation of a National Industrial Research Board to make an immediate investigation into these questions, and definitely and finally establish a condition of affairs which will meet, with safety, the needs of the country, both for the present and the future."

The issue also contains a very elaborate and valuable paper by Mr. J. Thomas on "Methods of Stowing for Indian Mines" which, together with the views expressed by the leading workers on this subject in the course of the discussion following the paper, will form an outstanding contribution to the study of this problem of great importance in the Coal Mining Industry in India at the present day.

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A recent Press Note issued by the **Indian Central Cotton Committee** gives a resume of the work on cotton carried out at the *Institute of Plant Industry*, Indore, since its inception in 1924. In 1932, the Committee reviewed its policy with regard to the work of the Institute and approved of a revised programme which included, besides different field experiments dealing with agronomic problems, (*a*) botanical classification and survey, (*b*) cotton breeding and selection, (*c*) cotton genetics, (*d*) physiology of the cotton plant, (*e*) influence of environmental factors on lint characters, and (*f*) field experimental technique. Considerable progress has been achieved in all these directions. A satisfactory classification of Asiatic cottons, complete and acceptable to taxonomists, has been published. A census study of the cotton crops in Central India and Rajputana has shown that the best yielding cotton is a balanced mixture of types and not a pure type. The mode of inheritance of quantitative characters in cotton is being intensively studied at the Institute, and a new technique has been developed to overcome the difficulty of environmental variation and for distinguishing it from genetic variation. Varietal trials have given results of great practical value and through seed-distributing organisations, the purity of new strains has been effectively maintained, thus ensuring the best monetary return to the cultivator. The Institute also provides training in various branches of cotton research to students selected by the Indian Central Cotton Committee.

A report on the **staple length of cotton** produced in India for the 1938–39 season has just been published.

The total production of cotton for the season is estimated at 5,120,000 bales of 400 lbs. each, the trade estimate being higher, *i.e.*, 5,979,000 bales (including a figure of 450,000 bales representing extra-factory consumption); of this it is estimated that 5 per cent. was of staple length 1" and over 32 per cent. of staple length 7/8" to 31/32". The corresponding percentages for the previous years were 4 and 27 respectively, showing thereby an increase in long and medium staple cotton production in India.

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Birthday Honours.—The Honours List issued on the 8th June, contains the following names of scientists:—

C.I.E.: Mr. H. R. Stewart, Director of Agriculture, Punjab; Mr. W. J. Jenkins, Officiating Director of Agriculture, Bombay; Lieut.-Col. F. T. Anderson, Professor of Surgery, Medical College, Calcutta. **O.B.E.**: Mr. E. J. Bruen, Live-Stock Expert to the Government of Bombay. **M.B.E.**: Mr. A. F. MacCullough, Advisory Chemist, Medical Stores Department, Madras. **Rao Bahadur**: Rao Sahib D. V. Bal, Agricultural Chemist to the Government of the C.P. and Berar; Rao Sahib S. L. Tambe, Special Officer for the Improvement of Cotton and Member of the Legislative Council, Indore State. **Rai Sahib**: Dr. Piare Lal Srivastava, Reader in Mathematics, Allahabad University, U.P., Babu Sajani Kumar Chatterji, Officer-in-Charge, Bacteriological Laboratory, Patna, Bihar.

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Lady Tata Memorial Trust.—The Trustees have announced the awards of the following scholarships and grants for the year 1939–40:—

(1) *International Awards*: Dr. Jorgen Bichel (Aarhus, Denmark), Dr. Julius Engelbreth Holm (Copenhagen), Dr. Maurice Paul Jean Guerin (Paris), Professor Dr. Karl Jarmai (Budapest), Professor J. McIntosh (London), Professor Eugene L. Opie and Dr. Jacob Furth (New York), Dr. Joachim Wienbeck (Breslau), Dr. Werner Jacobson (Cambridge), and Dr. Edorado Storti (Pavia, Italy).

(2) *Indian Scholarships*: Mr. K. Ganapathi (Bangalore), Mr. M. Sadashiva Rao (Bombay), Mr. T. J. Job (Calcutta), Mr. M. K. Halder (Dacca) and Mr. P. L. Narasinha Rao (Bangalore).

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Dr. K. N. Kaul, Lucknow University, has been appointed as a member of the staff of the Royal Botanic Gardens, Kew.

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Dr. W. L. Davies, Research Dairy Chemist and Analyst, National Institute for Research in Dairying, Shinfield, near Reading, has been appointed Director of the Imperial Dairy Research Institute.

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Dairy Science Abstracts.—The Imperial Bureau of Dairy Science will shortly publish a quarterly journal called *Dairy Science Abstracts*, the purpose of which will be to provide a survey in English of the current literature of dairy science from all parts of the world. The Table of Contents will include (1) Husbandry, (2) Technology, (3) Control and Standards, (4) Economics, (5) Physiology, (6) Bacteriology and Mycology and (7) Chemistry and Physics. At present this literature is published in a variety of languages and scattered in a large number of journals, many of which are not generally available to workers in dairy science. Particular attention, therefore, will be paid to information published in less familiar languages or in journals with a limited distribution.

The first number will deal with literature received or examined by the Bureau during January, February and March 1939. A number will appear every three months; four numbers will constitute a volume. To facilitate reference each number will contain an author index, and each volume, author and subject indexes.

The annual subscription, inclusive of postage, will be:—For residents of the countries of the British Commonwealth and the Anglo-Egyptian Sudan who send their subscriptions direct to the Bureau, 20/-. For all other subscribers, 25/-. Single parts, each, 7/6.

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Spectrographic Analysis in Great Britain.—Edited by A. C. Candler (Adam Hilger Ltd., London), 1939. 80 Pp., limp cloth covers: 7*s.* 6*d.* net; 7*s.* 9*d.* post free.

Although specialised spectrographs for use in industry originated in Great Britain and are widely used here, the fact has received relatively little notice in scientific or other publications.

This record of the uses to which the spectrograph is being put in 28 British factories and research laboratories may therefore come as a surprise to many who still regard chemical analysis as the only method of determining the elements present.

The applications are extremely diverse. About half the contributions deal with the analysis of metals and alloys and these show that analysis by the spectrograph is accurate enough to replace chemical analysis for the routine control of many alloys, while where a factory is producing metal for 99% pure or has to keep definite impurities down to less than a fraction of 1%, the spectrograph is likely to be as accurate. In every case it is much quicker.

Other contributions deal with subjects as widely separated as brewing, the refining of sugar, the manufacture of silica ware, the analysis of soil and diseases of sheep. To take the last only, a disease common in Somerset has been shown to be associated with a small trace of molybdenum in the herbage; traces as small as are here important would hardly have been revealed by chemical analysis.

* * *

The Spectroscope is being used in an increasing measure for stndardising vitamins. The spectroscopic requirements for riboflavin have recently been investigated by Dr. H. R. Kreider of the American Medical Association's Chemical Laboratory. Dr. A. E. Ruehle of the Bell Telephone Laboratory has made extensive use of ultraviolet absorption spectroscopy for studying the chemical reactions of vitamin B_1. For the assay of vitamin A the spectroscope offers, perhaps, the best method. Evidence

has accumulated to show that more than one vitamin A occur, all very similar in physiological effects. The existence of these have been revealed by the spectroscope.

A routine list of spectrographic apparatus required for vitamin A assay work in the pharmaceutical or food industries is given in the *Bausch & Lomb Instrument Bulletin*, No. 43 (January 9, 1939). Special problems involved in the spectroscopic analysis of the several vitamins should be referred to Messrs. Bausch & Lomb, Rochester.

* * *

Announcements

J. N. Tata Endowment for Advanced Studies.—Applications for studentships available for advanced study out of India, will be received *not later than the 31st July 1939*, by the Secretary, J. N. Tata Endowment for Higher Education of Indians, Bombay House, Fort, Bombay. Applications should be in the prescribed form which can be had on application from the Secretary, and must be accompanied by copies of testimonials as to character, special aptitude and physical fitness (including eyesight) and a photograph of passport size. Applications of students who have graduated with conspicuous distinction will be considered.

Three studentships shall be given to Parsi candidates for every studentship awarded to a non-Parsi candidate but if eligible Parsi candidates are not available, further studentships will be available to non-Parsi candidates.

The Executive Committee of the **International Union against Tuberculosis** has announced the award of a biennial prize of 2,500 French Francs in memory of the late Prof. Leon Bernard, who was the Founder and for fourteen years the Secretary-General of the Union. The prize will be awarded for the second time in 1940 to the author of an original essay on "Conjugal Tuberculosis" in French or in English. The essays must be typewritten or printed and must not exceed 10,000 words. They must be forwarded to the Secretary, Tuberculosis Association of India, 20, Talkatom Road, New Delhi, not later than March 1, 1940.

The Adult Education Committee of the **Central Advisory Board of Education** in India meets in Simla on July 17, 18 and 19. The Committee which was appointed at the fourth annual meeting of the Central Advisory Board of Education held in New Delhi on December 3, 1938, to examine the problem of adult education in India and to report to the Board, consists of the following members:—

(1) The Hon'ble Dr. Syed Mahmud, Minister of Education, Government of Bihar (*Chairman*); (2) The Hon'ble Mr. Sampurnanand, Minister of Education, Government of the United Provinces; (3) Rajkumari Amrit Kaur; (4) Mr. W. H. F. Armstrong, I.E.S., Director of Public Instruction, Punjab; (5) The Educational Commissioner with the Government of India.

The following have been co-opted members of the Committee:—

(1) The Hon'ble Mr. Varkey, Minister of Education, Madras; (2) Mr. Bhagwat, Chairman, Adult Education Committee, Bombay; (3) Mr. J. J. Ghandy, General Manager, Tata Steel and Iron Works, Ltd.; (4) Dr. W. A. Jenkins, Director of Public Instruction, Bengal.

Agricultural Training at the Imperial Institute of Agricultural Research.—The date for admission to the post-graduate courses of the Imperial Agricultural Research Institute, New Delhi, has been changed from November 1 to October 1 from the next session, according to a press note issued by the Principal Information Officer, Government of India.

Though a research organization at which studies are made of fundamental agricultural problems of general or all-India importance, or of such problems as cannot be properly or conveniently investigated by the Provincial Departments of Agriculture, the Imperial Agricultural Research Institute is also a higher teaching institution, providing post-graduate courses as well as facilities for special research, for selected graduates of Provincial Agricultural Colleges and distinguished science graduates of Indian Universities.

The **Third All-India Obstetric and Gynaecological Congress.**—With a view to facilitate collection of data relating to the three principal subjects of discussion at the ensuing Congress, *viz.*, (1) Anæmia of pregnancy; (2) Functional uterine hœmorrhage; and (3) Maternity and child-welfare, the provisional scientific committee have formulated a scheme, copies of which can be had on application from Dr. S. Mitra, M.B., Secretary, Provisional Scientific Committee, 3, Chowringhee Terrace, Calcutta.

We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, Nos. 6 and 7.

"Agricultural Gazette of New South Wales," Vol. 50, Part 5.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 4.

"The Nagpur Agricultural College Magazine," Vol. 13, No. 4.

"The Indian Journal of Agricultural Science," Vol. 9, Pt. 2.

"L'Agricoltura Coloniale," Vol. 33, No. 4.

"Biochemical Journal," Vol. 33, No. 4.

"Berichte der deustschen chemischen Gesel-Ischaft," Vol. 72, No. 5.

"Journal of the Institute of Brewing," Vol. 45, No. 5.

"Journal of Chemical Physics," Vol. 7, No. 5.

"Journal of the Indian Chemical Society," Vol. 16, No. 3.

"Chemical Age," Vol. 40, Nos. 1034–1038.

"Journal de Chemie Physique," Vol. 36, No. 2.

"Chemical Products," Vol. 2, No. 1.

"Experiment Station Record," Vol. 80, No. 4.

"Indian Forester," Vol. 65, No. 6.

"Forschungen und Fortschritte," Vol. 15, Nos. 13–15.

"Transactions of the Faraday Society," Vol. 35, No. 217.

"Transactions of the Geological, Mining and Metallurgical Society of India," Vol. 10, Nos. 3–4,

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

May 1939. SECTION A.—SIR C. V. RAMAN AND V. S. RAJAGOPALAN: *The Structure and Optical Characters of Iridescent Glass.* A study of numerous specimens and of 30 photomicrographs of the same shows that the structures in decomposed glass may be divided into six categories exhibiting distinct optical phenomena. The colours of decomposed glass actually become more striking when the material is covered by liquid. K. G. KRISHNAN: *Dispersion of Ultrasonic Velocity in Liquids.* There is no definite evidence of acoustic dispersion over the frequency range 1·5 to 7 mc. in the cases of xylol, benzene, carbon tetrachloride, carbon disulphide and water. L. A. RAMDAS, B. N. SREENIVASIAH AND P. K. RAMAN: *Variation in the Nocturnal Radiation from the Sky with Zenith Distance and with Time during the Night.* The equivalent black body temperature of night sky as a whole as calculated from thermopile measurements agrees within 2° with that measured with a Pyrogeometer. C. R. MEHTA: *Chemical Investigation of the Seed-Oil of* Oroxylum indicum *Vent.* An yellow crystalline substance (m.p. 274°) and a fatty oil have been isolated and examined. H. GUPTA: *Analogues of Bauer's Theorems.* H. GUPTA: *On a Problem of Arrangements.* K. BAPAYYA: *Effect of Temperature on the Characters of the Wings accompanying the Rayleigh Lines in Liquids.* In the cases of chloroform and benzene, different portions of the continuous wings are found to be depolarised to the same extent, *viz.*, 0·86, both at room temperatures and high temperatures. Depolarisation of the total scattering, however, in benzene diminishes from 0·44 at room temperature to 0·11 at 260° C. S. MINAKSHI SUNDARAM: *On an Infinite System of Non-Linear Integro-Differential Equations.* S. CHOWLA: *On a Problem of Arrangements.* K. NAGABHUSHANA RAO: *Diffraction of Light by Supersonic Waves—Part I.* The amplitude expressions for the diffracted orders are worked out *in extenso.* B. R. SETH: *Potential Problems Concerning Curved Boundaries.*

May 1939. SECTION B.—P. R. PARUKUTTY: *On a collection of Algæ from Assam*—Twenty-six forms out of which ten belong to the Chlorophyceæ and sixteen to the Myxophyceæ have been described. One variety and five forms are new. G. W. CHIPLONKER: *Echinoids from the Bagh Beds—Part II.* The examination of fossils from the various exposures, leads to the conclusion that the different constituents of the Bagh Beds must be assigned to a single geological age, the observed differences being due to only lithological facies. The echinoids from the Beds must be regarded to mark the Cenomanian and very probably the lower Cenomanian age. ALI MOHAMMAD AND ABDUR RASHID KHAN: *Root Development of Certain Oilseed Crops of the Punjab.* A Study of the Root Habits of Representative Types of Toria, Sarson, raya or rai and taramira. S. JONES: *On the external gills of* Acentrogobius viridipunctatus *(Day).* External gills are unknown in Teleostei and those in *A. viridipunctatus,* the origin, structure and degeneration of which are described in this paper, are the first of their kind. B. P. PAL AND B. B. MUNDKUR: *Studies in Indian Cereal Smuts—I. Cereal Smuts and their Control by the Development of Resistant Varieties.*—An introductory paper to a series dealing with the results of investigations on the relative resistance of strains of wheat, oats and barley to their respective smuts. M. K. SUBRAMANIAM: *Studies on the Structure of the Golgi Apparatus—V. The Idiosome in the Pancreas of the Toad and its Possible Relation to the Ergastoplasm.* The Golgi apparatus and mitochondria were studied in acinar, duct and islet cells of the pancreas, and the suggestion of Subramaniam and Gopala Aiyar that the idiosome may form a core to the Golgi apparatus is substantiated. P. N. MEHRA AND H. L. MEHRA: *Life-history of* Stephensoniella brevipeduncu-lata *Kash.* MAHESHWAR SINGH SOOD: *A peculiar case of Caudal Abnormality in* Hemidactylus flaviviridis *Rüppel.*

National Academy of Sciences:

March 1939.—V. L. VARMA AND S. DUTT: *Indigoid dyestuffs derived from Chrysoquinone.* K. B. MATHUR AND G. R. TOSHNIWAL: *F-Region Ionization in June 1938 at Allahabad.* R. BEHARI: *Osculating quadrics of a ruled surface.* B. P. PANDE: *On the Trematode Genus* Lyperosomum *Looss, 1899 (Dicrocœliidæ) with a description of two new species from India.* B. P. PANDE: *Two new species of trematodes from* Anhinga melanogaster, *the Indian Darter or Snake-Bird.*

Indian Association for the Cultivation of Science:

February 1939.—M. N. SAHA AND K. B. MATHUR: *The propagation and the total reflection of electromagnetic waves in the ionosphere.* BHOLANATH ROY: *Raman spectra of co-ordination compounds.* JAGATTARAN DHAR: *Crystal structure of diphenylamine, Part I.* M. F. SOONAWALA: *The internal pressure in liquids.* D. SUBRAHMANYAM: *A new theory of Lapse Rate.* R. R. BAJPAI AND B. D. PANT: *Further Studies of F-region at Allahabad.*

Indian Chemical Society:

March 1939.—MATA PRASAD AND D. M. DESAI: *The effect of the addition of non-electrolytes and of temperature on the times of setting of some transparent inorganic gels.* SISIR KUMAR GUHA: *Dyes derived from acenaphthenequinone —Part VII.* 2-(5-*Chloro*)-*thionaphthene-acenaphthyleneindigos.* M. N. RUDRA: *Manganese content of Indian foodstuffs and other materials.* N. L. VIDYARTHI AND M. NARASINGA RAO: *Chemical examination of the wax from sugarcane.* DUHKHAHARAN CHAKRAVARTI AND NIRANJAN CHAKRAVARTY: *Constitution of halogenated resaceto- and propiophenones.* DUHKHAHARAN CHAKRAVARTI AND BROJESWAR MAJUMDAR: *Limited applicability of Kostanecki's reaction. The influence of Halogen atom on the reaction.* S. RANGASWAMI: *A note on methyl-β-resorcylate.* M. NARASIMHAM AND S. N. PAL: *A note on the analysis of certain algæ.*

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Some Aspects of Cotton Industry in India

THE cultivation of cotton in India dates back to pre-historic times. Until a few years ago our only sources of information regarding the antiquity of cotton were scanty references in religious books, which left it uncertain whether India or Egypt was the first country to grow and manufacture cotton on a large scale. Recently, however, when the excavations at Mohenjo-daro made 'the dead yield up their secrets', a few specimens of beads, razor blades and other household articles were unearthed, which were found to be wrapped up in some kind of textile material. Time had treated this material none too gently, it was so tender that it fell to pieces in handling; with great care, however, some pieces of fibres and bits of yarn were removed from it, and these showed unmistakably the characteristics of cotton. It was thus proved, beyond a shadow of doubt, that the world is indebted to India for the first steps in the cultivation and manufacture of cotton, which to-day constitutes over 75% of all the textile materials.

These tests, which were carried out at the Technological Laboratory of the Indian Central Cotton Committee, further revealed the fact that as far back as 3500 B.C., not only was cotton being cultivated in India, but that its manufacture had reached a surprisingly high standard for those ancient times. Since then the cultivation and manufacture of cotton in India made a steady progress, until, in the middle ages, the fame of her fabrics spread far and wide, and she did a flourishing trade in textiles with other countries. The enchanting beauty of her muslins and nainsooks and the amazing variety in design and colour of her fabrics have become legendary and need no repetition;

what is perhaps not generally known is the fact that, as late as 1815, India exported to England alone cotton goods worth £1,300,000. These halcyon days of industry and prosperity were followed by a dark period of decline and depression, when India lost not only the major part of her export trade in cotton fabrics, but also the seed of some of her best cottons. The development of her own textile mills and the demands for raw cotton from outside markets helped to revive the industry and to expand the area under cotton. During the last few decades efforts have been concentrated upon improving the quality of the indigenous types or upon the introduction of exotic varieties, which may give a higher monetary return to the grower. Although these efforts have, to some extent, been thwarted by bad picking, defective ginning, adulteration, watering, etc., it can be claimed that a very definite measure of success has already been achieved.

India to-day occupies first place in the British Commonwealth of Nations and the second place in the whole world in respect of the total *quantity* of cotton produced each year. The area under cotton has ranged from 22·4 to 27 million acres in the last decade, yielding a crop of 4½ to over 6 million bales per annum. But India of to-day is not a mere cotton-producing country. Beginning in a modest way in 1851, her textile industry has developed steadily until in 1937 her 370 mills, equipped with over 9 million spindles and nearly 2,00,000 looms employed over 4,00,000 hands, and produced more than 3,000 million yards of cloth. Even these huge figures do not complete the picture; India, after satisfying the major portion of her own needs, has been able to export every year nearly 3 million bales, worth about Rs. 30 crores, in these days of low prices, to other countries. Thus, if we consider the triple aspects of cultivation, manufacture and export trade, cotton represents easily the largest and the most highly organised industry of India.

The cultivation of cotton in India possesses certain features, which are not seen, at least to the same extent, in the other principal cotton-growing countries. It will be instructive to consider them briefly. In the first place, cultivation of cotton in India is not confined, as is the case in the United States of America or Egypt, to a narrow belt in which the soil and climatic conditions do not undergo large variations. With the exception of Bengal, Bihar, Assam and the N.W.F. Province, cotton is grown over the entire length and breadth of this sub-continent. This wide-spread cultivation has two important consequences. Firstly, owing to the widely different conditions of soil and climate prevailing in different parts, the Indian cottons range in quality from the coarse and short-stapled Bengals (which incidentally are not grown much in Bengal) to the fine and long-stapled Sind-Egyptian or Punjab-American 289 F. Probably no other country in the world offers such a striking contrast either in the times of sowing and harvesting of its cottons or in their physical characters. Secondly, each large tract has its own special problems of varietal improvement, agronomy, cotton diseases and pests, etc.; and though co-ordination is desirable to avoid duplication, it is necessary that botanical, physiological and agronomical researches must be carried out at several centres. For this purpose funds, and more funds, are required, which should be made available in view of the position which cotton occupies in our national economy and industrial development.

The second peculiar feature of the Indian cotton crop is its low yield per acre. The

average for the whole country for the last 10 years has been only 85 lbs. of lint per acre, which is very poor as compared with the American average of 190 lbs. per acre and miserable as compared with the Egyptian average of 446 lbs. A direct result of this low yield is that unless the price of cotton is high, the small cultivators, owning a few acres of land, live in a state of semi-starvation, and after satisfying their bare needs have no money left to put back into the land. Unless some extraordinary events occur, the world factors do not indicate that any substantial increase in the price of cotton is likely to occur in the near future. It is, therefore, essential that the means which are already being adopted to increase the yield per acre should be intensified so that the farmers may raise their standard of living. These means consist of the development of high yielding varieties, the use of manures and fertilisers, the supply of water by canals, wells and tanks to areas which depend at present upon the vagaries of monsoon, the conservation of moisture by bunding, the prevention of soil erosion by reafforestation, the application of better methods of sowing and tillage, the elimination of weeds and the control of pests, etc. Some of these measures like elimination of weeds, preparation of bunds, etc., the farmer himself can undertake provided they are demonstrated to him; in others like the supply of cheap fertilisers and manures, maintenance and supply of pure seeds, control of pests, etc., he needs the assistance of co-operative bodies or the Local Governments; in yet others like irrigation schemes, re-afforestation, etc., he is directly dependent upon State aid. Some of these measures are being tried in limited areas; it is necessary that they should be extended considerably; others have been sadly neglected, it is imperative that they should be taken in hand according to a well-designed plan. Only in this way will it be possible to re-habilitate the fertility of our soils and improve the condition of the millions who derive their living from it.

The third peculiar feature of the Indian cotton crop is the distribution of the different varieties in it. We have mentioned above that these varieties cover a wide range of staple length, but the distribution is far from being even; the comparatively long types are grown in small quantities, while the short-stapled types are grown in superabundance. It is estimated that in the total crop of over 6½ million bales of 1936–37, only 200,000 bales or 3% possessed a staple of 1" or more, while fully 4 million bales or 66% possessed a staple of 11/16" or under. These percentages offer a striking contrast to conditions in U.S.A., where out of a total crop of 12 million bales in 1936 only 9·5% were shorter than 14/16". The direct result of this grossly uneven distribution of varieties in regard to length is that while, on the one hand, we are burdened with a surplus of short-stapled cottons for which we must find export markets, on the other hand we are faced with a deficiency in long-stapled cottons for the growing needs of our cotton mills. It is, therefore, necessary that we must plan the development of our improved varieties and their cultivation on such a scale that the supply of different types fits in more appropriately than at present with our requirements in the home market and abroad. If such measures are co-ordinated with those directed towards raising the yield per acre, it is possible that we may have to reduce the total area under cotton. There are some 'marginal lands' where the cultivation of cotton under the present-day conditions is hardly a paying proposition; if the yield in

other lands is raised and improved types are grown on them, these marginal lands can well be utilised for growing food crops of which there is a considerable deficiency for our vast and rapidly increasing population.

We have made a passing reference to the large quantities of cotton purchased each year by other countries which in 1937–38 amounted to nearly 17% of our total exports. The Indian cottons have to sell in an open world market in competition with the produce of other countries; it is therefore very necessary that the quality and grade of our cottons should be maintained at as high a level as possible so that the agriculturists may reap the maximum profit from their labours. The terms 'quality' and 'grade' are sometimes vaguely used as being synonymous; when applied to cotton, each has a definite significance. Quality refers to the physical characters of the fibre such as average length, fineness, maturity, etc., which have a bearing upon its spinning performance; while grade refers to the amount of trash and foreign matter such as leaf, seed-coat bits, sand, etc., present in the cotton. Improvement in quality is a slow and difficult process, but improvement in grade can be effected more quickly and easily by paying proper attention to picking, pre-cleaning, ginning and pressing. It is unfortunately the case that often the good quality Indian cottons do not obtain their full value on account of their poor grade. The presence of leaf bits, cut and unripe seeds, stains, etc. 'hits the customer in the eye', so to say, and detracts from the real merits of the cotton. These defects can be removed by cleaner picking and better ginning and pressing. For the former vigorous propaganda is necessary; for the latter both propaganda as well as systematic investigations on the optimum conditions of ginning Indian cottons are required. During the last few years a great deal of work along these lines has been done in the United States of America, where the authorities are fully alive to the necessity of improving, or at least maintaining, the grade of their crop in these days of severe competition; in India with the exception of a few large firms we have eschewed this important field. It is, however, a matter of gratification to note that the Indian Central Cotton Committee has recently sanctioned a scheme for starting a Ginning Section at its Technological Laboratory, where these problems will be studied in a scientific manner and the results placed at the disposal of the ginning factory owners.

While we are on the subject of quality and appearance of the Indian cottons, we may also mention two other sources of weakness, which require increased attention and vigorous steps to eradicate them. These are the two malpractices commonly known as watering and mixing. The former consists in deliberately adding water to cotton, over and above what it normally absorbs from the atmosphere, in order to increase the weight of the bale. The water thus added makes the fibres matted and helps to multiply the bacteria and fungi, which, to a greater or less extent, are generally present in cotton, but which do not thrive in a dry atmosphere. These micro-organisms, if allowed to grow when the cotton is stored for some time, destroy the cotton fibre, give it a peculiar dirty-grey colour and altogether reduce the quality of the material. In view of the damage done by watering, every effort should be made to stop this malpractice. In some cases the Provincial Governments have passed the necessary legislation to punish those who indulge in it; this should be extended immediately wherever this undesirable practice raises its head.

The second malpractice consists in deliberately adulterating a good quality cotton with an inferior and cheaper cotton and passing it off as the former. This practice is more widespread than watering, and because the detection of two cottons in a mixture presents certain technical difficulties, it is more difficult to tackle successfully. It enables the party indulging in it to make a short-lived profit, but as the mills fail to obtain the expected results, they grow suspicious and the whole district, or even the tract, suffers in reputation. Vigorous propaganda, backed by legislative measures such as preventing the transport of inferior varieties in the areas growing superior cottons are necessary to curb this malpractice.

The two malpractices referred to above are objectionable from another point of view. During the last two decades considerable amount of work has been done in evolving new and improved varieties, in which the Indian Central Cotton Committee has played a very important part. This work has entailed the labours of a large number of research workers and the expenditure of moderately large sums of money. It is capable of yielding the best results only if the varieties so evolved are grown in a pure state and presented to the customers in an unadulterated and clean condition. If these pre-requisites are not fulfilled, neither the growers nor the consumers would get the fullest benefit from the efforts of the research worker, who is sometimes blamed by persons, not in the know of facts, for not producing spectacular results.

These are some aspects of the Cotton Industry in India relating to its progress from the field upto the factory. There are others which relate to its treatment within the factory and its utilisation for other than textile purposes. We shall deal with these in a subsequent issue.

NAZIR AHMAD.

The Institute of Optics, University of Rochester

OPTICAL instruments are playing an increasingly important rôle in modern science and industry. The biologist needs his microscope, the engineer his transit, the metallurgist his spectroscope, the movie technician his camera and floodlights, the astronomer his telescope, and the flight navigator his drift indicator and sextant. Specialised knowledge and skill are required in the design and manufacture of all these instruments. "Optics" has thus become a profession which demands the service of experts in optics and optical engineering. The future of the profession is no less promising: already, more and more opportunities are provided in the applications of photo-electric cells, the electron microscope, television, etc.

It was essentially to meet these demands that the University of Rochester, founded in 1930 an Institute of Optics, with the enthusiastic co-operation of the famous firm of Bausch & Lomb Optical Co. The Eastman Kodak Co. has also made substantial contributions towards the establishment of this Institute. Rochester is in the centre of the great Optical Industry of America and by associating the Institute, with the well-known Department of Physics of the University, unique facilities are afforded for full instruction in all the fundamentals of optics and at the same time connecting the classroom work with research and practical achievement in the profession itself. The course is a four-year one, leading to the degree of *Bachelor of Science* in Optics. Those interested in further details, regarding expenses, student life at Rochester, list of courses, etc., are invited to write to the Director, The Institute of Optics of the University of Rochester, Rochester, New York.

autotetraploids also form trivalents and univalents, parallel with bivalents and quadrivalents. Abnormal distribution of the univalents and the members of the trivalent and quadrivalent groups during the meiosis is one of the most essential causes for the reduction of fertility in autotetraploids and for their survival, because they lead to formation of disbalanced (in respect to the chromosome numbers) gametes. (A relative reduction of the velocity of the pollen tube growth especially of the disbalanced gametes is another factor that conditions reduced fertility.)

The degree of fertility is the most essential factor, that regulates the survival of the new tetraploid.

Allotetraploids, derived from F_1-hybrids with asyndetic meiosis (*I*) usually have normal meiosis (forming only bivalents, rarely univalents) and are highly fertile. Allotetraploids derived from F_1-hybrids with complete allosyndetic meiosis (*II*) behave very much like the autotetraploids forming bivalents, quadrivalents, trivalents and univalents and usually have, like them, somewhat (or highly) reduced fertility. Allopolyploids derived from F_1-hybrids with partial allosyndesis during the meiosis (*III*) occupy a position between the two extremes (*I*) and (*II*).

On the basis of the preceding statements we can logically deduce that autopolyploid forms derived from species with short chromosomes should survive better in nature, because they form more bivalents and less quadrivalents (trivalents too), than those derived from species with long chromosomes. Allotetraploids derived from F_1-hybrids with allosyndesis should behave in a similar way. Consequently, polyploid species in nature with long chromosomes of a higher degree of polyploidy would have most frequently an allopolyploid origin; F_1-hybrids from which such species have been derived should have, most probably, asyndetic meiosis or only partial allosyndesis. There is a relatively small chance for the survival of autotetraploid forms derived from species with long chromosomes and of allotetraploids with long chromosomes, derived from

F_1-hybrids with normal or high allosyndesis during the meiosis. Studying a series of polyploid forms existing in nature and experimentally produced, as well as the drawings of chromosomes in diploids and polyploids, made by other investigators, I obtained data which support strongly these deductions. Autopolyploid forms, with largest chromosome numbers found in nature are derived from species with small chromosomes. Such forms are, for example, *Silene ciliata* Pourr. with $2n = 24$, 48 and 192 chromosomes, *Dianthus sinensis* L. (*Seguieri* Vill.) with $2n = 60$ and 90 (*Dianthus superbus* L., — *arenarius* L., having $2n = 30$ and 60) chromosomes, etc. (*cf.* the list of the autopolyploids given by Müntzing[16]).

Autopolyploidy induced in plants with long chromosomes leads to high or complete sterility. *Triticum vulgare* autotetraploids[17,18] ($2n = 84$) produced by abnormal temperatures were self-sterile. Auto-octoploid *Tr. durum*, which I grew, was also self-sterile. Genus *Nicotiana* has much shorter chromosomes than *Triticum*. Autotetraploids *N. alata* ($2n = 36$) and *N. longiflora* ($2n = 40$), which I produced, by colchicine and acenaphthene were highly fertile, while the octoploid *N. alata* ($2n = 72$) was self-sterile. In other words, high polyploidy also reduces fertility.

I shall further consider a series of plants in which the species with large chromosome numbers have small chromosomes. Smith[19] (1937) studied the chromosome numbers in *Dioscoreaceæ*. His drawings show that *Dioscorea caucasica* ($2n = 20$) and *D. quinqueloba* ($2n = 20$) have large chromosomes, the species *D. reticulata* ($2n = 61$) and an undefined sp. ($2n = 40$) have medium chromosomes, while *D. batatas* ($2n = 144$) has small chromosomes. Similar regularity can be found in studying the drawings made by Baldwin[20] (1936) of the *Crassula* karyotypes. The species of the division *Turrita*, namely, *Crassula barbata* ($2n = 14$) and *C. hemispherica* ($2n = 14$) have large chromosomes, while *C. nodulosa* ($2n = 56$) has medium chromosomes. The species from other divisions, namely, *Crassula sarmentosa* ($2n = ca.\ 60$), *C. multicava* ($2n = ca.\ 112$) and *C. spatulata* ($2n = ca.\ 148$) have short chromosomes. The species of the genus *Griffinia* studied by Satô[20a] also represents an excellent example in this respect. In genus *Sedum*[21] no noticeable difference exists in the chromosome length of the species with small and with large chromosome numbers, they all have, however, short chromosomes. The chromosomes of diploid *Lobelia* species (*inflata, syphilitica, dresidensis,* $2n = 14$), as drawn by Okuno[22] (1937), have large chromosomes, tetraploid species *L. sessilifolia* ($2n = 28$) has medium chromosomes, and hexaploid species *L. Richardsonii, triquetra* and *Erinus* ($2n = 42$) have small chromosomes. *Geranium erianthum* ($2n = 30$) has long chromosomes, *G. Sanguineum* ($2n = 84$) has short chromosomes as the drawings of Sakai[23] (1935) showed. His[24] drawings also showed that diploid *Aconitum* species (*umbrosum* and *yuparense,* $2n = 16$) have longer and thicker chromosomes than tetraploid *A. sachalinense* ($2n = 32$) and *A. subcuneatum* ($2n = 32$). The drawings of Tanaka[25] (1937) showed that *Scirpus mucronatus* ($2n = 42$) has the largest chromosomes, *S. cyperinus* var. Wichurai ($2n = 66$) has medium and *S. Maritimus* ($2n = 110$)—the smallest chromosomes. But, in general, genus *Scirpus* has small chromosomes in comparison with *Triticum*, for example. Strekova[26] (1938) studied and drew the chromosomes of the genus *Alopecuros* (*A. æqualis,* $2n = 14$; *A. ventricosus,* $2n = 28$; *A. glacialis,* $2n = 56$; *A. borealis,* $2n = 98$). According to her drawings, *A. æqualis* ($2n = 14$) has the largest and the thickest chromosomes, while *A. borealis* ($2n = 98$)—the smallest and the thinnest. Delaunay[27] (1926) studied the chromosome number and size of *Muscari, Bellevalia* and *Ornithogalum* and found that species with smaller chromosome numbers have usually longer chromosomes, attempting at the same time to evaluate this statement, phylogenetically, though in a different aspect. Examining numerous drawings of the karyotypes of a large number of species of phanerogamous plants made by Matsuura and Sutô[28] (1935), one feels easily convinced that species with gigantic chromosomes have not large chromosome numbers. Such species are: *Hepatica triloba* ($n = 7$), *Anemone flaccida* ($n = 7$), *Diphylleia Grayi* ($n = 6$), *Trautvetteria japonica* ($n = 8$), *Achlys japonica* ($n = 6$), *Sironema fragrans* ($n = 6$), *Hyacinthus orientalis* ($n = 8$), *Disporum sessile* ($n = 8$), *Aloe* sp. ($n = 7$), *Gesteria* sp. ($n = 7$), *Howarthia* sp. ($n = 7$), etc. It should be noted that all species of *Howarthia*[29, 30] hitherto studied are diploids ($2n = 14$). No polyploid *Lilium* species have been yet found, the whole genus having long ($n = 12$) chromosomes. Genus *Dianthus,* on the other

hand, has very small chromosomes and according to the data of Blackburn and those of Rohweder (*cf. Tischler,*[31] 1931) 25 species have $2n = 30$ chromosomes, 9 species have $2n = 60$ chromosomes and 11 species have $2n = 90$ chromosomes. The species *D. plumarius* has $2n = 30$ and 90 (Rohweder) and species *D. prolifer* has $2n = 30$ and 60 chromosomes. *Betula*[32] and *Populus*[33] have small chromosomes; *Betula* species having $2n = 28$, 56, 84 and even 90 chromosomes, and *Populus* species: $2n = 38$ and 57 chromosomes. The species *Betula japonica* has $2n = 28$ and 56 chromosomes. *Fragaria, Viola* and *Campanula* species also have relatively small chromosomes. *Fragaria*[31] has a polyploid series between $2n = 14$ and 84. The smallest chromosome number in *Viola* is $2n = 12$, the largest $2n = 96$. The species of the genus *Campanula*[31] have $2n = 16$, 32, 34 and 102 chromosomes. In *Gramineæ* there are genera with long chromosomes (*Triticum*, $2n = 14$, 28, 42; *Secale*, $2n = 14$; *Ægilops* $2n = 14$, 28, 42, etc.) and genera with shorter chromosomes (*Leersia,*[34] *Ehrharta,*[35] *Saccharum,*[36,37] *Setaria,* etc.). *Secale* species are only diploid. The polyploid species of *Triticum* and *Ægilops* have $2n = 28$ and 42 chromosomes, all of them being allopolyploids. New allopolyploid forms with $2n = 56$ have been experimentally produced, but they usually have somewhat reduced fertility. In the genus *Leersia*[34] on the other hand, the following chromosome numbers were reported by Hirayoshi[34] (1937): $2n = 48$ (*L. hexandra*), $2n = 60$ (*L. oryzoides* and $2n = 96$ (*L. japonica*). In *Saccharum*, species with $2n = 60$, 80 and with 112 (*S. spontaneum*) chromosomes have been reported by Bremer. *Setaria* species have $2n = 18$, 36 and 72 chromosomes (Kishimoto, 1938). The species *Agropyrum elongatum* ($2n = 70$) has relatively long chromosomes and, at the same time, a large chromosome number. The cytogenetic investigations showed, however, that this decaploid species is most probably allopolyploid, at least in respect to four genoms, only one being perhaps presented twice; the most reliable genom formula of it being AA BB CC X_1X_1 X_2X_2. *Narcissus dubius* ($2n = 50$) represents a similar case. It has the largest chromosome number of this genus. All *Narcissus* species have long chromosomes. Cytogenetic studies by Fernandes[39] (1937) showed that this species is an auto-allopolyploid having two genoms of *N. juncifolius* ($2n = 14$) and one genom of *N. tazetta* ($n = 11$), the genom formula of *N. dubius* being $\frac{JJT}{JJT}$. Cytogenetic studies also showed that *Helianthus*[38] *tuberosus* ($2n = 102$) is most probably an allo-autopolyploid having a genom formula $\frac{At_1\ At_2\ Bt}{At_1\ At_2\ Bt}$, the genom Bt being closely related to *Helianthus annuus* ($2n = 34$) genom. But *H. tuberosus* still has abnormalities during the meiosis and reduced fertility. If this species does not propagate vegetatively it hardly would survive. It has medium chromosomes.

The mode of propagations (vivipary) seems also to "protect" high polyploidy in some alpine and arctic plants (grasses). It seems that low temperatures (especially at night) favour polyploidy. At low temperature the chromosomes become shorter thus offering smaller segments for conjugation and for chiasma formation. Cold reduces pairing and chiasma formation. This is most probably due to an increase in the cytoplasmic viscosity and shortening of the chromosomes.

I shall also consider here the long list of chromosome numbers recorded by Sutô[40] (1936) in *Liliaceæ* and *Amaryllidaceæ*. It is not very suitable for our studies because no drawings were given, but nevertheless, he classified the karyotypes into four groups which fit generally quite well to the general principles here outlined. Idiograms of the type *Yucca—Agave* (4–5 long + *n* dots) were designated YA; further TD = *Tofieldia—dracœna* (*n* dots); LN = *Lilium—Narcissus* (*n* longs); and UP = *Uvularia—Polygonatum* (*m* longs + *n* dots). Species with large chromosome numbers have most frequently idiograms TD and YA (*Hosta, Drimiopsis, Yucca, Cordyline, Dracœna, Sanseviera, Agave, Fourcroya, Beschorneria, Polyanthus*).

One can also conclude from the drawings made by Hagerup[41] (1938) that there are species in genus *Orchis* with large (*O. maculatus* var. *Meyeri*, $2n = 40$; *O. ustulatus*, $2n = 42$) and such with small chromosomes (*O. purpureus*, $2n = 42$; *O. sambucinus*, $2n = 42$; *O. incarnatus*, $2n = 40$). The polyploid forms, *O. latifolius* ($2n = 80$) and *O. maculatus* var. *genuinus* ($2n = 80$), however, have small chromosomes. The case with *O. maculatus* shows that a crowding of the chromosomes in the polyploid form is connected with somewhat smaller size of the chromosomes. Such a conclusion

might be premature, especially when it is drawn from polar views of meiotic chromosomes. Examining, however, the size of the somatic chromosomes of diploid *Artemisia borealis* ($2n = 18$) in respect of those of the tetraploid variety *bottnica* ($2n = 36$) drawn by Erlandsson[42] (1939), I think that such a tendency does exist. Variety *bottnica* has somewhat smaller chromosomes. In comparing the chromosome size of diploid and octoploid *Nicotiana alata*, I had the same impression, namely, that the octoploid species had somewhat thinner and shorter chromosomes than the diploid one. There is a very striking difference in the chromosome size between those of *Plantago lanceolata* var. *altissima* from Bucharest ($2n = 12$) and those of *P. lanceolata* var. *altissima* from Munich ($2n = 96$), studied by McCullagh,[43] the chromosomes of the diploid form ($2n = 12$) being about 4 or 5 times larger in size than those of the *16-ploid*.

It seems that hydration (viscosity degrees) and nutrition processes (*i.e.*, differences in amount of substances, present in the nucleus, resp. passing through the nuclear membrane, necessary for chromosome growth and reproduction in polyploid large nuclei, where the chromosomes are more crowded in comparison with those of the diploids, where they are less crowded) are responsible for these differences in degree. It should be pointed out here that smaller nuclei, typical for the diploids, can be better supplied by the cytoplasm with substances necessary for the growth and reproduction of the chromosomes than the large polyploid nuclei, since the former nuclei have larger surface in relation to their volume than the latter. The decrease of the ratio $\frac{\text{nucleus surface}}{\text{nucleus volume}}$ with the euploid increase of the chromosome numbers is probably the main factor that suppresses the frequency of the cell division in high polyploids. Octoploid *Nicotiana alata* ($2n = 72$), for example, has larger nuclei and larger cells than the tetraploid ($2n = 36$) and diploid ($2n = 18$) *N. alata*, it was, however, smaller in size, *i.e.*, it had much smaller number of cells. Our more recent observations also suggest that the decrease in the $\frac{\text{nucleus surface}}{\text{nucleus volume}}$ ratio with the euploid increase of the chromosomes in plants regulates the change in the leaf index (a decrease of $\frac{\text{length of the leaves}}{\text{breadth of the leaves}}$ with the euploid increase of the chromosomes).

In the trend of this discussion I shall call attention to the better survival of polyploids than of diploids with some chromosome deficiencies (deletions), which also lead to differentiation of karyotypes with some shortened chromosomes. This process might often occur during the chromosome differentiation (genic and structural) of the newly raised polyploids until they change from plants with multivalent chromosomes during the meiosis into plants with bivalent chromosomes.

Some cytogenetic data suggest that the chromosome size is under genic control.[4] It does not seem improbable, that some polyploids have survived, because they are mutants with short chromosomes. A too great crowding of chromosomes in polyploids of higher degree, especially when the latter are large and even medium in size also interferes with the meiotic processes. Autotetraploids *Nicotiana alata* ($2n = 36$) and *N. longiflora* ($2n = 40$), for example, have a much normal meiosis and higher fertility than the autotetraploid forms of *N. rustica* ($2n = 96$) varieties. The latter varieties set only on the average 10 to 25% of seeds. It should be pointed out that *N. rustica* is an allopolyploid species its haploid forming usually 0-1 bivalents. One of the essential factors for the reduction of fertility in high polyploids is obviously the reduction of the ratio $\frac{\text{average diameter of the pollen mother cells}}{\text{average diameter of the meiotic equatorial plates}}$ with the euploid increase of the chromosomes. This ratio for *N. rustica* diploid is 1·783 and for *N. rustica* tetraploid —1·496. Another important factor that is responsible for some abnormalities during the meiosis is the size of the leptotene nuclei. High polyploids are more likely to form less quadrivalents (proportionally) and more univalents, because the chromosome pairing attraction should be inversely proportional to the square of the distance between the chromosomes at leptotene. If two homologous chromosomes occupy diametrically opposite positions in a very large polyploid nucleus, their pairing attraction might be so reduced that they may fail to pair. It seems quite logical that the crowding itself of the chromosomes in polyploids with large chromosome numbers would reduce pairing and chiasma formation. Insignificant external conditions that interfere with the meiotic processes (temperature, viruses, etc.) would induce in such high polyploids greater meiotic disturbances than in plants with smaller nuclei.

Preceding considerations of the significance of chromosome size and number are of importance from a practical point of view. It might be suggested that polyploids (especially autopolyploids) when produced for practical purposes should be better derived (when possible) from plants with smaller chromosomes (in size) and with smaller chromosome numbers.

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Professor J. C. Ghosh, D.Sc., F.I.C., F.N.I.

(*Director, Indian Institute of Science, Bangalore*)

THE news of the appointment of Professor J. C. Ghosh as Director of the Indian Institute of Science will, we are confident, be received with generous enthusiasm both in India and abroad, and we have pleasure in offering him our warmest felicitations on his elevation to what we regard as the Pontifical Chair in the realm of Indian Science. It will be recalled that as the Head of the Department of Chemistry in the Dacca University, his strenuous labours have established a flourishing school of chemical research, whose contributions have as much significance in the field of theoretical knowledge as they have important practical applications in industry. Professor Ghosh's achievements have brought him blushing honours, thickly and surely. He was one of the organising members of the Indian Chemical Society of which he became

President in 1924. He was one of an aggregate of a hundred eminent scientists who assisted at the birth of the National Institute of Sciences. The coveted distinction of President of the Indian Science Congress came to him in 1938. As a member of the Advisory Board of the Imperial Council of Agricultural Research and of the Governing Body of the Indian Research Fund Association he rendered conspicuous service. His eminence as a research worker in the field of pure and applied branches of chemistry and soil science was recognised by his appointment as a member of the National Planning Committee. Such gifts, at once rich and varied, he now proposes to dedicate to the service of the Institute, whose resources and facilities ought to furnish him with opportunities for inaugurating new lines of scientific and industrial research, which would bring credit to him and enrich the traditions of this great foundation. Professor Ghosh has an arduous task before him, and on the eve of initiating it, we offer him our best wishes for unmixed success.

Rao Bahadur Professor B. Venkatesachar, M.A., F.Inst.P., F.N.I.

ON the eve of relinquishing his office as Officiating Director of the Indian Institute of Science, we have great pleasure in offering Rao Bahadur Professor B. Venkatesachar our warmest wishes for a happy and contented life in his retirement. He was summoned to occupy the Director's post under the stress of circumstances prevailing in 1937, which he accepted purely in a sense of disinterestedness and in a spirit of patriotic service. During the two years in which he administered the affairs of the Institute, his efforts were generously understood and greatly appreciated. In a way he felt called upon to play the rôle of John the Baptist, making things smooth and easy for his successor to continue the work which Professor Venkatesachar had laboured hard to stabilise. We wish him many long years of happiness and usefulness.

LETTERS TO THE EDITOR

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The Ultra-Violet End of the Solar Spectrum

It is well known that the solar spectrum as observed at the earth's surface is cut off suddenly towards the ultra-violet at about 3000 A and that this is due to the presence of ozone in the earth's atmosphere. Dobson's ozone survey (1928–29)[1] and recent measurements made (in 1936–38) at Bombay[2] clearly show that smaller amounts of ozone (about 0·200 cm. at N.T.P.) occur over the tropics than over higher latitudes. In the light of these results of ozone measurements, the best places for a further attempt at extending the ultra-violet limit of the solar spectrum would be the tropics. Fabry and Buisson[3] in Marseilles reached 2885 A, while Götz[4] in Arosa has been able to observe the spectrum up to 2863 A. However no photograph of the spectrum has been published beyond 2912 A. The best published photographs are due to Fabry and Buisson (1921). (Please see Fig. 2 for a reproduction.) These photographs were obtained by means of a double spectrograph of quartz; the authors varied the time of exposure in different portions of the spectrum according to the intensity of the

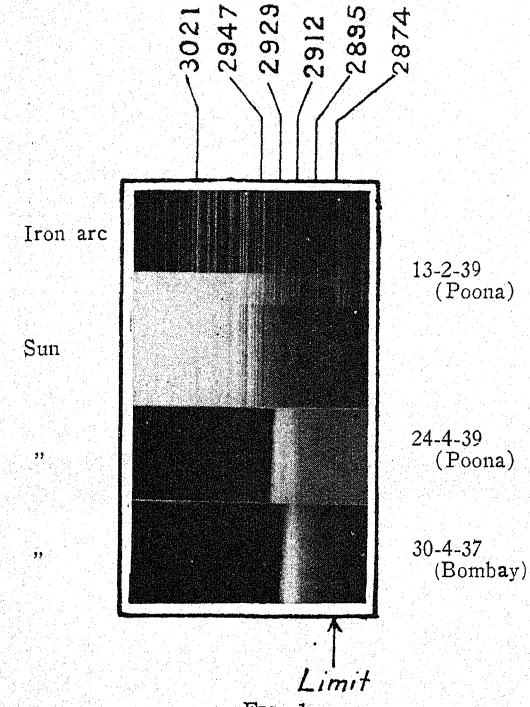

Fig. 1

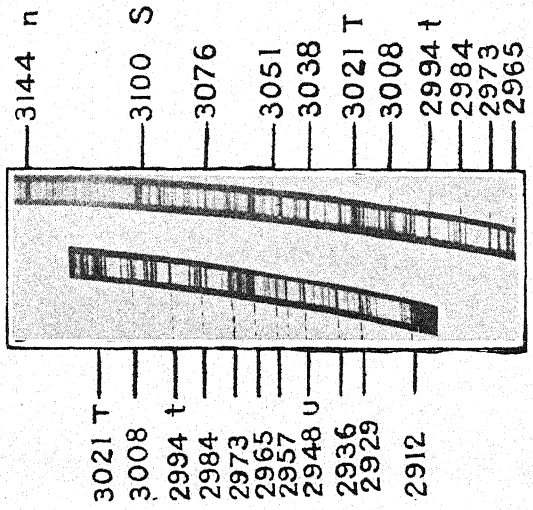

Fig. 2

[From Fabry and Binsson, *Astroph. Journ.*, 1921, 54, 297.]

spectrum there. Götz also used a powerful double spectrograph and long exposures.

The present attempt was made at Poona to find the limit that could be reached (latitude 18° 32′ N.) with a simple Dobson's spectrograph. To cut off the brighter portions of the spectrum a chlorine-bromine filter was used. The instrument was adjusted to photograph the u.v. spectrum in the region 3300 A to 2840 A only. For the present purpose, the optical wedge which is usually placed in front of the photographic plate, was removed and unwanted portions of the spectrum and also the light scattered in the instrument were meticulously eliminated by pasting black paper in different parts of the instrument. A composite picture, with the spectrum of an iron arc superposed on one of them, is reproduced here. These pictures were not taken on the same day but are only placed side by side accurately. During April and May, when the sun is nearly overhead in these latitudes and the skies are perfectly clear at noon, one can photograph the spectrum, on any day, up to about 2900 A with an exposure of 10-15 mins. on an Ilford special rapid or similar plate. On the 24th April 1939, the limit reached was 2895 A; while on the 30th April 1937, exposed under similar conditions at Bombay (latitude 18° 54′ N), 2874 A was reached. Here also, the intensity of the region beyond 2895 A is extremely small and reproduction is not possible.

In order to bring out the very faint lines recorded beyond 2912 A, intensity measurements were made with a Skinner-Dobson microphotometer of the plate exposed on the 30th April 1937. These are shown in Fig. 3. Although the curve shows some lines near 2863 A, extension of the spectrum so far is not beyond doubt.

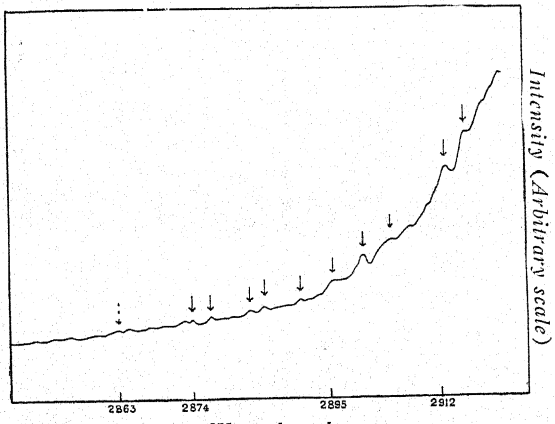

FIG. 3.

In spite of the great care taken to avoid scattered light reaching the plate, small traces could not be avoided owing to the imperfection in the prism and reflecting mirror. This light was sufficiently strong to drown the extremely weak short wave-length region; and exposures longer than 15 mins. could not bring out any further detail. For the present, therefore, 2874 A is the limit that can be attained with this instrument; and for further extension, which does not seem impossible, a double spectrograph and longer exposures must be tried.

I am very thankful to Dr. K. R. Ramanathan for his guidance and Dr. D. D. Karve of the Furgusson College for allowing me the free use of his laboratory.

M. W. CHIPLONKAR.

Poona,
June 16, 1939.

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A Case of Variegation in *Capsicum annuum* L.

IN the March issue of the *Journal of Heredity* a case of variegation in *Capsicum* has been reported by Cochran.[1] A similar case has been observed by me at the Botanical Section, Imperial Agricultural Research Institute, New Delhi.

In the first week of August 1938, a variegated seedling (Fig. 1) was noticed among the progeny raised from the mixed seeds of non-bagged plants of the chilli variety, Pusa Type 51 (for its description please see Shaw and Khan,

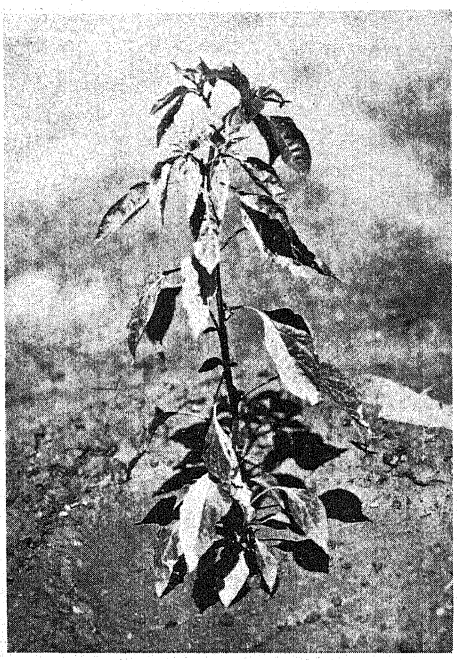


FIG. 1

1928).[2] The leaves on one side of the main shoot, starting from the sixth node, were variegated and those up to the fifth node, as well as on the other half of the main shoot, were normal green. The proportion of green, yellowish green, yellow or white areas forming the variegation in these leaves, varied.

The branches arising out of the axils of variegated leaves were entirely variegated and those from the axils of green leaves were green. The pedicels and calyx lobes of flowers on the variegated branches had faintly marked bands of pale green and yellow colour running longitudinally. In the unripe fruit also, similar bands radiating from the apex to the base, could be seen, the apex being almost entirely yellow or creamy.

Some of the variegated and normal green branches were selfed separately and also crossed reciprocally.

The selfed seeds of fruits from the normal green and variegated branches, as also those of the crosses, were sown in May 1939. The cotyledonary leaves in all cases were normal to start with, but in the case of the progeny of the variegated branches, they quickly turned yellow and the seedlings died within four or five days after germination. The progeny of normal green branches as well as the hybrid seedlings are normal green.

The variegated portion of the plant, which is chimerical (sectorial) in nature, appears to have arisen as a bud mutation. The component parts, green and variegated, forming the chimera, breed true, the progeny from the latter, however, being incapable of independent existence due perhaps to the deficiency of chlorophyll or through being associated with a lethal factor. The normal green condition is dominant over the chlorophyll deficient condition in F_1 and in F_2 a 3 : 1 segregation is expected in which the recessives are not likely to survive.

This case is thus parallel to the one reported by Cochran, the only difference being that whereas in the latter case the fruits on the variegated branches dropped before reaching maturity, in my plants the setting was normal. Had Cochran tried to cross the two types of branches, instead of waiting to effect crosses between their respective progenies, it is likely that he would have been successful in making at least a one-way cross, *viz.*, green × variegated.

R. B. DESHPANDE.

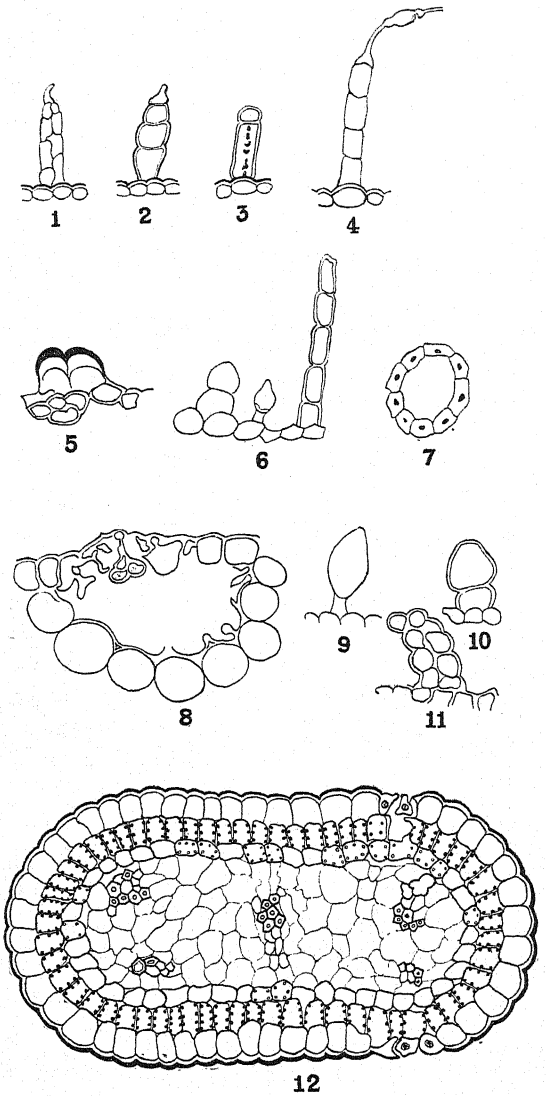
Imperial Agricultural Research Institute,
New Delhi,
July 4, 1939.

[1] Cochran, H. L., J. *Hered.*, 1939, **30**, 81.

[2] Shaw, F. J. F., and Khan, A. R., *Mem. Dept. Agri. Ind.* (Bot. Ser.), 1928, **16**, 59.

On the Anatomy of Some of the Compositæ

IN the following article the authors have recorded their observations in brief on the anatomy of three Compositæ, namely, *Vicoa auriculata* Cass., *Grangea maderaspatana* Poir., *Glossocardia linearifolia* Cass. All the three are very common in Hyderabad, and grow under more or less xerophytic conditions on gravelly and rocky soil. This investigation was taken up



FIGS. 1–7. *Vicoa auriculata* Cass.—(1) Biseriate conical shaggy hair; (2) Uniseriate conical hair; (3) 2-celled cylindrical hair; (4) Long multicellular hair; (5) Glandular hair on the stem; (6) Pear-shaped and ordinary multicellular hairs; (7) Resin canal. All × 250.

FIG. 8. *Grangea maderaspatana* Poir.—Secretory cavity with papillose differentiation of the epithelium. × 250.

FIGS. 9–12. *Glossocardia linearifolia* Cass.—(9) and (10) Pear-shaped trichomes; (11) Curved multicellular biseriate trichome; (12) T.S. leaf, showing stomata, thick cuticle, broad layer of epidermal cells, palisade tissue and vascular system. All × 250.

because, owing to the vast scope of this family, our knowledge of the anatomical features is still imperfect. It is proposed to deal with these plants separately.

1. *Vicoa auriculata* Cass.

The hairy covering in the stem consists of biseriate or multiseriate broadly conical shaggy hairs with a small pointed terminal cell (Fig. 1), uniseriate hairs with a conical terminal cell (Fig. 2), 2-celled cylindrical hairs (Fig. 3), and long multicellular trichomes with broad basal cells and with long constricted and pointed terminal cells (Fig. 4). Yet another type of hairs occurs. These glandular hairs possess hardly any stalk, and consist of four cells arranged in two rows (Fig. 5). In the leaf besides the ordinary hairs, peculiar bladder-like or pear-shaped trichomes also occur, although very scantily (Fig. 6). Oxalate of lime is excreted in the form of rhomboidal crystals in all parts of the plant.

Resin canals occur both in the stem as well as in the root (Fig. 7). In the former they are endodermal and are opposite the vascular bundles, but in the root they are endodermal as well as cortical. Resin canals are wanting in the leaf. Finally the occurrence of hard bast at both ends of the vascular bundles may also be mentioned.

2. *Grangea maderaspatana* Poir.

The hairy covering is very scanty and consists of multi-cellular trichomes like those described in the case of *Vicoa*, but some of them are bent at an angle to the stalk.

Oxalate of lime occurs in the form of very minute octahedral crystals.

The chief feature of the stem is the occurrence of secretory cavities with papillose differentiation of the epithelium in the cortex (Fig. 8). They are absent from the root. In the anatomical structure of the stem the poor development of hard bast as compared to that of *Vicoa* is striking.

3. *Glossocardia linearifolia* Cass.

The hairy covering consists of shortly-stalked pear-shaped trichomes (Figs. 9 and 10), and curved multicellular biseriate trichomes (Fig. 11).

The root is devoid of any hair covering. Oxalate of lime occurs in the form of octahedral crystals, those in the root being smaller than those in the stem and leaf.

Resin canals without any epithelial cells occur in the cortex of the root. They are not seen in the stem.

Leaves are 2-pinnatisect with linear apiculate segments. Stomata are present on both the surfaces, but are in greater numbers on the lower. They are surrounded by three or more ordinary epidermal cells. Large epidermal cells form a thicker layer than the palisade tissue. A marked xerophytic character is the presence of thick cuticle (Fig. 12).

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M. MOINUDDIN.

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June 29, 1939.

Leaf Crinkle—A Transmissible Disease of Papaya

IN the course of raising papaya (*Carica papaya*) seedlings in the Mycologist's pot culture house at Coimbatore, the authors came across a few seedlings which showed definite symptoms of a disease, which they believe has not been described before. The symptoms are: The stem instead of growing erect assumes a slightly zig-zag appearance. The leaves are slightly crinkled and the lobes of the palmatifid lamina curve downwards and inwards and the entire leaf assumes the shape of an inverted cup (Fig. 1). On the underside of the leaves the veinlets are thickened, slightly gnarled, dark green in colour and opaque when held against the light. The seedlings which show symptoms of the disease grow without appreciable stunting in growth and continue to exhibit the symptoms throughout. When pollarded such seedlings give rise to leaves which show the characteristic symptoms. Examination of roots, stem and leaves did not show the presence of any associated organism, nor was there any indication of any insect infestation.

FIG. 1

Left: Healthy plant. *Right:* Infected plant. The disease having been transmitted by grafting (photographed eight weeks after the first symptoms were noticed).

With a view to finding out if the disease is transmissible, seedlings showing symptoms were grafted to six perfectly healthy seedlings by the inarching method. Symptoms developed on three of the grafted plants within a period of 120 days.

A photograph of a normal plant and one showing the disease accompanies this note.

K. M. THOMAS.
C. S. KRISHNASWAMI.

Agricultural Research Institute,
Coimbatore, S. India,
June 10, 1939.

Discovery of a Species of *Coeloplana* Commensal on the Star-fish *Pentaceros hedemanni* in the Sea off Krusadai Island, Gulf of Mannar[1]

WHILE going through the literature on species of *Cœloplana* with reference to the species recently discovered by Prof. W. M. Tattersall,[2] the Assistant Director Dr. D. W. Devanesan and I had occasion to peruse Dr. Mortensen's paper on "Two New Ctenophores" wherein he has described *Cœloplana astericola,* a commensal on a star-fish *Echinaster luzonicus.*

On 23rd February 1939, while collecting specimens of the star-fish *Pentaceros hedemanni*

common round Krusadai Island, I noticed red patches on their bodies. When detached and examined under the microscope, they were found to be clusters of a species of *Cœloplana*. Dr. Devanesan who examined them on the 10th March 1939 is also of the opinion that their organisation and the presence of the two long tentacles with their uniserial branches left no doubt that they were *Cœloplanæ*. As they are uniformly red, they seem to be different from *Cœloplana astericola* Mortensen, which is said to be mottled red and white. Dr. Devanesan and I are continuing our observations on this new species of *Cœloplana* and hope to be able to publish ere long a brief account of its structure and habits.

S. VARADARAJAN.

Marine Biological Station,
Krusadai Island,
Gulf of Mannar,
June 16, 1939.

[1] Published with the permission of the Director of Fisheries, Madras.

[2] *Curr. Sci.*, 1939, 8, 157.

A Note on the Biology of *Lucilia sericata* Meigen (*Calliphoridae, Diptera*) in Baluchistan

Lucilia sericata Meigen (Family Calliphoridæ, Order Diptera), the larvæ of which cause cutaneous myiasis in sheep skin is a species of great economic importance. Its attack is particularly severe in Europe, North America, South Africa and Australia. In India it has previously been recorded by Sinton (1921) and Patton (1922), the adults having been bred from cases of human cutaneous myiasis in the North-West Frontier Province. Last year the writer reported the occurrence of this sheep blowfly causing cutaneous myiasis in sheep in Baluchistan (Janjua, 1938). A study of this pest undertaken in the beginning of 1937 has revealed some interesting facts about its biology and these are recorded in this note. The identification of the species has been done by the Imperial Institute of Entomology, London, to whom I am grateful for the help rendered.

Sheep farming is one of the principal occupations of the people of Baluchistan as the area of pasturage is unlimited and the hillsides and valleys of the Province are covered with grass and other succulent plants which afford excellent grazing for sheep. But the presence of *Lucilia sericata* is causing a grave concern to the sheep farmers of Baluchistan. As a result of investigations carried out by the writer for the last three years it has been ascertained that about 20–25 per cent. of the sheep in the Quetta-Pishin, Loralai and Zhob districts of the Province are under the attack of the maggots of this fly.

The sheep attacked by the fly is easily noticed with its head bent down and not feeding normally. It is irritable, uneasy, constantly shaking and when feeding, is frequently seen to stamp one hind leg. The diseased sheep has the habit of looking back over the shoulder and wagging its tail in a characteristic manner. During rest it avoids sun and seeks the nearest shady place. The wool on the affected part shows a dirty greyish-black stain and closer examination reveals a sticky fluid with a peculiarly offensive odour. The maggots of the fly feed in the wool and the adjacent skin, causing the latter to fester and the wool to loosen and become putrid, thus exposing the inflamed flesh with the whitish maggots tunnelling into it. The injuries gradually become transformed into serious ulcers with great loss of tissue. There is a rapid loss of condition and invariably death follows.

The female flies are usually attracted to the sheep after a shower of rain during the rainy season by the odour arising from the fleece. The eggs are then laid in the wool and the maggots on hatching cause lesions in the skin. Any wound, however small, is an added attraction and sheep affected with foot-rot or those with shoulders and loins denuded of wool by rubbing or biting are frequently attacked.

The female deposits her eggs in clusters of from fifteen to twenty-seven and as many as two hundred eggs may be laid at one time. A single female during her life-time may lay about 1,000 eggs. The eggs are mostly laid on

wool which is wet with fæces or urine, the soiled hind quarters of the sheep being especially attractive to the flies. The wounds left on the body of the animal after shearing are also the common places where eggs are laid.

The egg (Fig. 1) is white and somewhat sausage-shaped. It is 1·3 mm. long and 0·39 mm. broad. The incubation period at different times in the seasons varied from 10 hours to 40 hours.

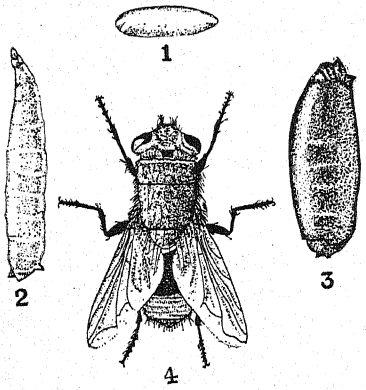

FIG. 1

FIG. 1.—Egg. × 11·5.
FIG. 2.—Larva. × 3·5.
FIG. 3.—Pupa. ×3·5.
FIG. 4.—Adult (female). × 3·5.

The maggot on hatching bores into the skin by means of sharply pointed mouth parts. They are found in squirming masses in the affected skin. During feeding they emit a slimy fluid which is chiefly responsible for the soiled appearance and rotting of wool in the infested patches of skin.

The full grown maggot (Fig. 2) is glistening white and 14 mm. to 16 mm. long and about 3 mm. broad. The mandibular hooks of the mouth parts at the anterior end are curved inwards and strongly chitinized. The anterior spiracles are provided with rings of spines which assist in locomotion. The body is cylindrical, slightly flattened dorso-ventrally, broad in the posterior region and is gradually narrowed towards the anterior end of the head. Besides the conical head there are eleven apparent segments—three thoracic and eight abdominal. In the intersegmental regions there are girdles of spines assisting the maggot in creeping through the skin. The larval period during the season varies from 5 to 11 days. When fully fed the maggot crawls away from the body of the sheep and drops to the ground where it burrows into the earth and remains as such before turning into a pupa. They are usually found within a depth of ¼ inch in the soil in an earthen chamber formed by caking of the soil. The prepupal period varies from 3 to 16 days during summer but this period is prolonged during the winter as hibernation takes place in this stage. The prepupæ are found at depths from 6 to 12 inches in winter and migrate to the surface during March next to turn into pupæ. The duration of the hibernating prepupæ ranged from 137 to 162 days.

In other sheep-rearing countries the mode of hibernation of *Lucilia sericata* varies. In South Africa the fly passes the winter in all stages except as egg and breeds continuously throughout the year (Smit, 1929). In New South Wales it is present at all seasons of the year (Gurney and Woodhill, 1926); in the United States it overwinters in the larval and pupal stage (Bishopp, 1916) while in New Zealand it strikes the sheep throughout the winter (Miller, 1921).

During pupation the body of the prepupa contracts as a whole, the anterior segments are entirely withdrawn and the anterior spiracles although occupying the same position as in the larva, lie at the anterior end of the body. The pupa (Fig. 3) is of a rich dark brown colour and is 8 mm. to 9 mm. long and 3·35 mm. broad. The duration of the pupal period during summer varied from 15 to 21 days and 28 to 33 days in spring.

When about to emerge, the fly, by means of a pulsating bladder-like organ on the front of its head, makes a circular slit at the anterior end of the pupal case and this cap-like portion is usually split into two halves by two lateral slits running forwards horizontally and meeting at the anterior end.

The adult fly (Fig. 4) on emerging is very soft and makes its way to some sunny spot where it spreads its wings and raises them up and down to facilitate drying. After a few hours the body and wings dry and the colours of the body become evident. For the description of the adult fly reference may be made to Patton and Evans (1929).

Mating takes place within five or six days after emergence and oviposition occurs within a day or so after copulation. The longevity of the flies under laboratory conditions ranged from 25 to 55 days. There are four generations of the fly each year; the first generation beginning from the end of March to the middle of May; second from the beginning of June to the middle of July; third from the beginning of August to the end of September while the maggots of the fourth generation overwinter in October and flies emerge out of them in March next.

The duration of the various stages in the life-history is summed up as follows: Egg, 0·30–0·40 days; Larva, 5–11 days; Prepupa, 3–16 days during summer and 137–162 days in winter; Pupa, 15–21 days during summer and 28–33 days in spring and Adult fly, 25–55 days.

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Department of Agriculture,
Baluchistan,
Quetta,
June 21, 1939.

Bishopp, F. C., *Journ. Econ. Ent.*, 1916, **8**, 317.

Gurney, W. B., and Woodhill, A. R., *New S. Wales Dept. Agric. Sci. Bull.*, 1926, No. 27.

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Patton, W. S., *Bull. Ent. Res.*, 1922, **23**, 113.

——, and Evans, A. M., *Insects, Ticks, Mites and Venomous Animals*, 1929, **1**, 407, 420.

Sinton, J. A., *Ind. J. Med. Res.*, 1921, **9**, 150.

Smit, B., *Union of South Africa Dept. Agric. Bull.*, 1929, No. 47.

Surface Structure of Polished Iridescent Shells

ELECTRON diffraction pictures were taken from the polished surfaces of the following iridescent shells:—

(1) *Lamelliderns marginalis*, (2) *Turbo*, (3) *Haliotis*, (4) *Nautilus pompilius*, and (5) *Margaritefera vulgaris*.

30 k.v. Electrons were used. The grinding and polishing were done with wet emery powder. The pictures show one or two diffuse rings, corresponding to a liquid or amorphous state. Thus it appears that here the process of polishing has converted the laminar body structure of the iridescent shells into an amorphous one.

In this connection it is worth recording that these shells in the polished state have been examined optically by Sir C. V. Raman[1,2,3] and by X-rays by Rama Swamy[4,5]; they find that in many cases the crystals of aroganite are arranged with considerable regularity so as to build up a laminated structure of nacre. The pieces of shells which are optically examined were about 0·1 mm. thick, and even here a body structure is observed. Thus the present work again shows that the electrons are even more suited for the examination of the surface structure than light.

This work was carried out in the Physics Department of the Indian Institute of Science, and my thanks are due to Sir C. V. Raman, for his kindness in placing the facilities of his department at my disposal.

K. R. DIXIT.

Gujerat College,
Ahmedabad,
June 12, 1939.

[1,2,3] Raman, C. V., *Proc. Ind. Acad. Sci.*, 1935, **1 A**, 567, 574 and 859.

[4,5] Rama Swamy, S., *ibid.*, 1935, **1**, 871 and 1935, **2**, 345.

REVIEWS

Tabelle der Hauptlinien der Linienspektren aller Elemente nach Wellenlänge geordnet. By H. Kayser. Second Edition, revised and enlarged by R. Ritschl. (Julius Springer, Berlin), 1939. Pp. viii + 269. Price 28·50 RM.

It is now thirteen years since the first edition of this indispensable table of Spectral Lines, compiled by Prof. H. Kayser appeared. Very soon after that date Spectroscopy grew apace at such a tremendous rate that within half-a-dozen years it reached a turning point in its development. We may now say that the interest of the scientific world which had been concentrated on the results of Spectroscopy since the advent of Bohr's theory has definitely shifted elsewhere, particularly to Nuclear Physics. But important advances have not been lacking in Spectroscopy in these years. Improved photographic materials have extended the region in the infra-red available to that technique; in the vacuum ultraviolet the advance has been still more remarkable, for now the gap between optical and X-ray spectra has been bridged. To take stock of all these developments and to make Prof. Kayser's book a faithful mirror of the same has been the task which has fallen on the worthy shoulders of Dr. Ritschl. The way he has discharged the onerous responsibility leaves little to be desired. The peculiar excellence of Prof. Kayser's book was the exhaustive and critical sifting of the available material that engendered such absolute confidence in its authority. Dr. Ritschl has also succeeded in keeping very close to this tradition. He has taken into account all the available literature and produced a book which faithfully reflects the present state of the science. Whereas Kayser's original Table in the sixth volume of his *Handbuch* devoted 5½ pages to the wave-lengths down to λ 7000 A.U. and stopped short at about λ 2000, the present Table has 32½ pages for the region down to λ 7000 A.U. and 38 pages are devoted to wave-lengths below 1600 A.U. The entries reach down to 32 A.U. Another marked improvement is that now most of the listed lines are definitely assigned to various stages of ionization. In its new edition, we are quite sure, the book will continue to render yeoman service, as only befits its pedigree,

A few remarks however seem to be called for regarding the sifting of the material that is so essential a part of the editorial responsibility in such a work. Regarding the wave-length data, the latest and best measurements have been utilised and since at present most authors do not differ except perhaps in the second place of decimals, there is little inconvenience in the fact that different observers have furnished the data accepted as authoritative in various parts of the same spectrum. But when we come to the question of intensities, there is an insuperable difficulty. Conditions of excitation are so various, and the intensity estimates of different observers are so markedly different and expressed also on such different scales that to adopt a uniform numeration for the whole of the material is an almost impossible task. And yet this is exactly what is most necessary in a table such as the one before us. Unfortunately Dr. Ritschl has decided to adopt the numbers furnished by the authority he has elected to follow, but since for different parts of the same spectrum or even for different lines observed in the same part of a spectrum under different conditions, different authorities have had to be relied upon, it is quite impossible to get a correct estimate of the relative intensities of two lines of the same spectrum even though they may not be distant more than 1 A.U. from each other. When such a table as the one under notice is to be used in identifying a spectrum or some part of it or even more so in quantitative spectrum analysis, this non-uniformity makes it very difficult to spot the lines or estimate the composition of their source. If at least all the lines measured by one observer and admitted into this book from his list had a label such as his initials to indicate the fact, this difficulty would not be so great. As it is, some wave-lengths taken from the old edition or from one particular observer have the same tabulated intensity in this edition also, but other intervening lines, if they happen to have been recently remeasured or measured by a different observer, carry intensity numbers quite impossible to compare with the others. Either all relative intensities, at least of neighbouring lines, should be brought down to a uniform scale, or some indication must be given regarding those relative intensities

which are comparable among themselves. The device of quoting alongside a line the next line observable under the same conditions may be another way out of the difficulty. Another point, brought out by a comparison of the present table with the original sources in a few typical instances, is that in one part of the spectrum even the strongest lines belonging to a certain stage of ionization have been omitted, while in other regions even less intense lines of the same ion are included. But, in practice, if the weak lines of a certain ion appear under any circumstances of excitation, the stronger lines of the same ion are bound to be present also. The absence of the latter from the table would thus be misleading. A further fact is also puzzling: it is that most of the numbers given in the present Table down to λ 9000 as being expressed in International Angstroms coincide completely with those given in Kayser's original Table (*Handbuch der Spectroscopy*, Vol. VI) and there expressly stated to be on Rowland's scale. The two scales however differ from each other sufficiently to make this coincidence ununderstandable. If some attention is paid to these matters, the reliability of this indispensable book is sure to be still further enhanced. We must finally thank Dr. Ritschl and the publishers for making available to spectroscopists this beautiful improved edition of Prof. Kayser's famous work.

T. S. S.

Text-Book of Heat. By R. W. Stewart and J. Satterly. Second Edition, revised by C. T. Archer. (University Tutorial Press, Ltd., London), 1939. Pp. viii + 410. Price 7*sh.* 6*d.*

This revised edition of the well-known text-book of Stewart and Satterly shows a marked improvement both in the external appearance and in the contents. The new format and type are much more elegant and pleasing. The additions are also extensive and important, much recent work being described. The treatment is inclined more towards being descriptive and practical, mathematics being restricted so as to exclude the Calculus. The descriptive portions of heat included in the book are more than ample for an Indian Pass Degree, though the theory is well within the attainments of Intermediate students. But the use of such elementary methods throws fresh light on the meaning of the equations developed, *e.g.*, in the sections on Conduction of Heat and Kinetic Theory. Very few important topics are omitted, but some account of Quantum Theory in connection with Radiation should surely be included so as to reflect in some measure the present state of the subject. A short section on the recent work on the cooling produced by the demagnetization of paramagnetic salts may not be out of place. The explanation of supraconductivity by the laconic statement that "copper and iron become almost perfect conductors at — 223° C." may also with advantage be replaced by a little more extended treatment. The conditions under which the results of Lees and Chorlton's experiment are expressed by the formula given in the book may be stated more expressly, particularly since this formula is different from the one usual in other books. Fig. 200 illustrating Forbes's method is misleading, since all the thermometers appear to indicate the same temperature. The definition of a molecule as 'the smallest portion of a substance which can exist in a free state and retain the properties of that substance' is surely wrong; it leads to the absurd conclusion that the same properties as those of matter in bulk are also possessed by the molecules. The statement on page 40 that in the example given, "the error introduced by taking L_1 instead of L_0 in the definition of the coefficient of expansion is 1 in 1700" is incorrect since the difference between L_1 and L is here only about 1 in 4000. We have noticed only three misprints: 'deduce' for 'deduct' on page 22; V_{ot} for $V_0 t$ on page 63 and Van de Waal's for Van der Waals' on page 293. This speaks rather for the excellence of the book than otherwise. In the same way our remarks above are not to be taken as in the least indicative of any lack of appreciation on our part. On the other hand, we heartily recommend the book for use in all Indian Universities, particularly inviting the attention of Pass Degree candidates to the excellence of the descriptive portion of this text.

T. S. S.

Regionale Geologie der Erde. Herausgegeben von K. Andrée, H. A. Brouwer und W. H. Bucher, Band 1. *Die Alten Kerne.* (*a*) The Indian Peninsula and Ceylon, by G. de P. Cotter; and (*b*) The Middle and West Australia, by E. de C. Clarke. (Akademische Verlagsgesellschaft m.b.H., Leipzig), 1938. Pp. 60.

At the invitation of the Akademische Verlagsgesellschaft, K. Andrée, H. A. Brouwer

and W. H. Bucher have undertaken to edit a "Regional Geology of the Earth" the scope of which is defined in the preface as follows: "The distinguishing feature of this work is the attempt to set forth in as small space as possible the development of the geology of the whole face of the earth, with special emphasis on those tectonic and magmatic events from which may be derived significant laws of geological development, with due regard to such features as accomplished and resulted from these processes, such as metamorphism, localization of ores, erosion and sedimentation. The major facts of stratigraphy are introduced as clues to and records of events, not as objects of study for their own sake". The work is divided into three volumes—Vol. I dealing with the Ancient Coigns; Vol. II with Palæozoic Plateaulands and Folded Belts; and Vol. III with the later Orogenic Belts.

The present number of Vol. I includes 2 parts, one on the Indian Peninsula and Ceylon by G. de P. Cotter, and the other on Middle and West Australia by E. de C. Clarke. In the first part which covers about 65 pages, there are 4 chapters dealing with the evolution of Peninsular India from the Archæan times to the present day, with frequent reference to the results of modern researches; and in Chapter 5 we have a summary of the main conclusions in the study of this geological history. In the second part dealing with Middle and West Australia, E. de C. Clarke follows a similar plan of treatment and gives a review of our present knowledge regarding the geological evolution of this part of the country.

It was an excellent idea on the part of the Akademische Verlagsgesellschaft, to have thought of publishing a 'Regional Geology of the Earth' on the lines they have proposed; and when completed, the publication is bound to be a valuable reference book for geologists all over the world.

L. RAMA RAO.

An Introduction to Botany. By Arthur W. Haupt. (McGraw-Hill Publishing Co., Ltd., London and New York), 1938. Pp. 396. Price 18*sh.*

Teachers of Botany have reasons to feel gratified at the regular stream of new books that have been coming forth on the subject during the last 6 or 7 years. Quite a number of these rank high as really teachable texts; others seem indifferent to the needs of the teacher as well as the taught, and a few are so poor that they need never have been published.

Even a cursory glance shows that Prof. Haupt's book ranks among those of the first category. The subject-matter has been presented in a clear and simple style, and the illustrations—both photographs and drawings —are splendid. The printing is excellent and typographical errors are so rare as to be negligible.

As mentioned in the Preface the book has been designed to serve as an Introductory text to fit a one semester course. For this reason descriptions have been kept brief and simple, although by judicious elimination of minor details the author has succeeded in including a very fair amount of information.

The student is first introduced to the macroscopic characters of the vegetative organs of the flowering plants and then to the microscopic ones followed by a discussion of the physiological processes taking place within them. A study of the flower and fruit comes later and then a very useful chapter on Heredity and Plant Breeding. The second part of the book deals with the various groups of the plant kingdom treated in an evolutionary sequence. Finally there is a chapter on the Plant Life of the Past and another on the Causes of Evolution. In the end there is a very useful index of 14 pages.

The book is satisfactory from every point of view, *viz.*, style, lay-out, accuracy of the illustrations and general get-up. The presentation is well balanced and it ought to be of considerable use to the Intermediate students of our colleges. The only thing that the reviewer would have desired is the addition of a chapter on Applied and Economic Botany. Many of the students will not have occasion to pursue higher studies in Botany and a knowledge of this kind would no doubt have a great cultural value in making them useful and well-informed citizens.

The publishers are also to be congratulated on such a carefully published and well illustrated volume.

P. MAHESHWARI.

The Principles of Electric Power Transmission by Alternating Currents. By H. Waddicor. Fourth Edition. (Chapman & Hall, Ltd., London), 1939. Pp. 458. Price 21/-.

The book would appear to serve the needs of University students of Electrical Engineering in the important subject of power transmission. It is written in clear language

but assumes a knowledge of applied mathematics of fairly high standard. It begins with the exposition of the fundamentals of inductance and capacities of conductors which are so essential to the student as well as the engineer. The chapters dealing with performance of transmission lines give the well-known methods. Considerable importance has been given to losses and thermal phenomena in cables, so little appreciated in this country.

Information about overhead insulators is rather meagre. The general principles of economics should serve as a useful guide to beginners, but experience and local conditions very often render the principles inapplicable and unsafe. The chapters dealing with the protective measures are informative and interesting. G. Y.

Geology of India—A New Edition. By D. N. Wadia, M.A., B.Sc., F.G.S., F.R.G.S., F.R.A.S.B., Geological Survey of India. (Macmillan & Co., Ltd., London), 1939. Price 24*s.* net.

The first edition of Mr. Wadia's *Geology of India* was published in 1916 with the object of "providing a manual, in the form of a modern text-book which summarises all the main facts of the subject, within a moderate compass". The need for such a standard text-book was becoming increasingly realised for several years before 1916, and Mr. Wadia's book was immediately welcomed as meeting this real want; and the fact that during all these years, there hasn't been another text-book of Indian Geology, written in India or outside, shows how admirably well Mr. Wadia's book has been serving the purpose for which it was intended. In view of the fact, however, that the study of Indian Geology has progressed enormously within the last 25 years, it was only natural that the book gradually came to need substantial revision. This has now been done, and we are glad to welcome this revised and enlarged edition. The general plan of treatment is the same as that in previous editions but the subject-matter has been "thoroughly revised and brought up-to-date by incorporating the results of new research". Several new diagrams have been added, and the value of the book is considerably enhanced by the addition of a beautiful and up-to-date Geological Map of India, on the scale of 96 miles to 1 inch.

In the chapters dealing with the Archæan System, the recent additions to our knowledge due to the researches of leading workers like Sir Lewis Fermor, Dr. A. M. Heron, Dr. J. A. Dunn, Dr. M. S. Krishnan and Mr. B. Rama Rao, in different parts of India, have all been briefly incorporated. In writing the chapters on the Gondwana System, Mr. Wadia has had the valuable collaboration of Prof. B. Sahni, to whom we owe practically all our recent knowledge of the fossil floras of the Gondwana System. In the chapter on the Deccan trap, there is a brief reference to the recent palæontological discoveries in the lower inter-trappean beds, and their bearing on the problem of the age of the traps. On this matter, Mr. Wadia summarises the present position thus: "From external evidence, it is quite apparent that the Deccan traps cannot be older than the Danian stage of the upper cretaceous, while from the internal evidence of fossil fishes, palms, and foraminifers, etc., they could not be much younger than the Eocene". It will be remembered that till very recently, the prevailing view in this matter was, in the words of Mr. Wadia in the first edition of his book: "From external evidences, it is quite apparent that the Deccan traps could not have been older than the Cenomanian stage of the upper Cretaceous, or much younger than the Danian stage of the very topmost Cretaceous". The chapter on the Eocene System includes the main results of the recent valuable researches of L. M. Davies and E. S. Pinfold embodied in their Memoir on the 'Eocene Beds of the Punjab Salt Range'. Attention has also been drawn to Mr. E. R. Gee's recent work which has demonstrated that the Saline series of the Salt Range is "clearly of Laki age, and not (as was previously thought) of Cambrian or pre-Cambrian age"—thus bringing them into line with a similar group of beds in the Kohat Dt. of known Laki age. Dealing with the rocks of the Glacial age in India, Mr. Wadia has given a valuable table showing the suggested correlation of Glacial stages, with the upper Siwaliks of north-western India, according to De Terra. The large volume of work that has been done within recent years on the structure of the Himalayas, especially in the western and north-western portions, by Dr. G. E. Pilgrim, Mr. D. N. Wadia, Mr. W. D. West and Mr. J. B. Auden, has been nicely summarised, with special reference to the main tectonic features of the three structure-zones —the Foreland, the Autochthonous Fold Zone and the Nappe Zone—in illustration of

which several digrammatic sections have also been given.

We have no doubt that this book by Mr. Wadia will continue to be popular with an ever-widening circle of students and teachers of Geology in India. Its value will also be very much appreciated by workers abroad—and their number is greatly increasing within recent years—who want to get familiar with the main outlines of the geology of this country.

The general get-up of the book is excellent. L. RAMA RAO.

Psychopathic States. By D. K. Henderson. (Chapman & Hall, Ltd., London), 1939. Pp. 179. Price 8/6 net.

This volume represents the sixth of a series of books based on Thomas W. Salmon Memorial Lectures delivered under the auspices of the New York Academy of Medicine, and comprises three addresses on "Place in Psychiatry", "Clinical Manifestations" and "Social Rehabilitation". The purpose of these lectures is to draw pointed attention to a group of unfortunate individuals, whose condition constitutes one of the fundamental problems of Society, and the author sets out in the three addresses to establish the need for socialization of these problems. The seriousness of these problems in relation to the well-being and progress of mankind does not receive, generally spaking, that consideration which their importance demands, and within the short compass of this interesting book, the author has presented his material and argument in such a skilful and attractive manner, that the reader is convinced about the urgency of medical, legal and public action.

The first discourse deals with a historical review of the place of the psychopathic state in psychiatric practice and literature and emphasises the necessity for intensive study. The topics included in this essay are the contributions of the various schools, the various components producing conduct disorder and constitutional medicine. Although psychiatry has advanced far ahead of other departments of medicine, still the study of psychopathic states remains not very clearly understood and differentiated. Medical science will therefore welcome the efforts of the author to focus pointed attention on the study of the motives underlying the conduct of people in our midst "semi-insane and semi-responsible", who, in every avenue of life, "not only are unable to conform adequately in their personal lives, but may even be responsible for some of the greatest social crimes in history".

The purpose of the subsequent lectures is to discuss such people, recognise them and bring them forward "into the noontide sun of revelation so that we can resolve matters on a more satisfactory and harmonious basis". The clinical manifestations of such men and women form the subject-matter of the second lecture, and the reader is presented with a sumptuous fare of fascinating problems such as "aggression, suicide, murder and assault, alcoholism and drug addiction, epilepsy, sex variants, criminality, cycloid states, schizoid states, talent and creative faculty" all profusely illustrated by typical cases. The instances, of course, form the mournful life-stories coming under the experience of professional psychiatrist, and the lay reader should be careful in holding his mental balance while perusing the morbid history of the decadence of human mind. The best of mankind, including, of course, authors and reviewers, cannot obviously escape from the pressures of the unconscious mind on the one hand, and from the developmental deficiency in the cerebral cortex on the other, each being a contributory cause for conversion of idealism and insanity, one into another: for in both cases men under the influence of ungovernable impulses shatter their minds against a world of hard realities. These facts which excite our sympathy also raise the more fundamental problems of how society can assuage the rigours of the misfortunes of the psychopath.

A wide survey of conduct disorder embracing all the manifestations of impaired mental health must necessarily lead to the formulation of attempts at social rehabilitation which is the subject of the third discourse. Here the author endeavours not only to change the complexion of psychiatry, but attempts "to open its eyes wider so that its obligations not merely to the individual but to the race, which after all, far transcends the individual, can be more adequately and justly performed".

This is a deeply interesting book which presents the matter of one of the most acute problems in an eminently attractive and readable form, and which will, therefore, be welcomed not only by the general practitioners in psychiatry, but also by the cultured public. In these days of "tensions", "appeasement", "aggression", "peace blocs"

and "axis rantings", the rival camps in their hurry to impeach the conduct of each other, have neither the time nor the inclination to test their own sanity, and democrats and dictators and communists, it is our confident hope, will find in this book much that will appeal to their rationality.

The Cause of Cancer. By David Brownlie. (Chapman & Hall, Ltd., London), 1938. Pp. 207. Price 7*sh.* 6*d.*

The cause of cancer is still shrouded in mystery in spite of extensive and intensive investigations. Recent researches have proved conclusively that chronic irritation due to various causes plays an important rôle in its development. Experimental investigations on animals have shown that coal tar and some of its derivatives can induce cancer. Among the proved causes of cancer may be mentioned: (1) Soot; (2) high temperature carbonization coal tar from manufactured towns' gas retorts and by-product recovery coke ovens; (3) other carbonization tars and crude oils, *e.g.*, shale oil; (4) certain varieties of lubricating oils, which give rise to the variety of cancer, known as, mule spinner's cancer.

Long continued irritation of some parts of the body may give rise to cancer, *e.g.*, cancer, following the irritation of a jagged tooth, gall stones, syphilitic ulcers, metal or other body warmers, containing burning charcoal, ('Kangri burn' cancer among certain hill tribes in Kashmir), too much exposure to X-rays. Cancer of the tongue and lips occurs among those smoking clay pipes and cancer of the bladder is known among aniline oil workers. In India, the greater incidence of cancer of the jaw and cheek in the West Coast appears to be definitely associated with the chewing of tobacco and the use of a particular variety of lime with it.

The above definite causes, however, are only responsible for an extremely small proportion of the incidence and mortality due to cancer. So far, nothing is known regarding the cause or causes of cancer, not attributable to the above factors and arising in other parts of the body.

The author presents in this interesting book a theory as to the etiology of cancer, based on rational grounds, which justify further research in the direction indicated. The author's theory is that cancer is possibly due to a large extent to the presence of certain poisonous organic substances in manufactured towns' gas and other combustion gases and in smoked foods. "A large proportion of cancer cases are due to eating contaminated food, resulting from the wide-spread use of contaminated towns' gas for cooking under conditions, as in most designs of gas cookers (ovens), that both the gas to some extent and all the waste combustion products are in direct contact with meat, bread, pies, cakes, biscuits, milk, puddings and other products."

Cancer causing poisons can be conveyed to the body in other ways than by direct contact with food. The dust emanating from tar macadamised roads is a potential cause of cancer. Another possible cause is the wide-spread pollution of the atmosphere by leakage from towns' gas supply. Among other factors of importance for the pollution of the atmosphere must be mentioned, the discharge of the waste combustion products of motor vehicles and presence of carbon monoxide in the waste combustion gases, formed in the burning of any type of fuel, gaseous, liquid or solid.

The theory of the cause of cancer, being due primarily to complex benzene ring hydrocarbons formed by high temperature carbonization, heat decomposition and combustion under certain conditions, should be carefully examined by cancer research workers. If the theory is proved, human misery due to cancer can be placed in the group of preventable diseases.

Mr. David Brownlie is a Chemist and a Chemical Engineer and not a medical man. His contribution is, therefore, limited to an analysis of the possibilities from the standpoint of one, who has had many years of experience in matters relating to combustion and carbonization. He realizes that his theory has not yet been proved.

I commend Mr. David Brownlie's book on *The Cause of Cancer*, especially to cancer research workers. All members of the medical profession and the public will profit by a perusal of this interesting book.

T. S. TIRUMURTI.

Forest Pathology. By John Shaw Boyce. American Forestry Series, First Edition. (McGraw-Hill Publishing Company, Ltd., London and New York), 1938. Pp. 600 + 216 illustrations.

Forest Pathology which deals with the diseases of living forest plants is a comprehensive study, but if it should extend to the timber affections as well, becomes too unwieldy a subject to be compressed into some

600 pages, unless in the hands of an expert like Professor Boyce. Though the book is mainly concerned with the diseases of North American plants, the application of its general principles could advantageously be made in a vast country like, for instance, India with its large stands of virgin forests. It is therefore a valuable addition to all forest libraries in this country and a great help to the research workers in this field.

The classification of diseases is a complicated task but in this book it has been much simplified being based mainly on the susceptible stages and parts of the trees such as "Seedling," "Root," "Foliage" and "Stem disease", etc., and an elaborate bibliography attached to each item makes the work specially valuable. The semi-diagrammatic illustrations and notes published therein, with reference to fungi lessen the difficult task of diagnosis, within the scope of the book.

The few references to foreign diseases, for instance the Spike-disease of Sandal, which is cited as a mere example of a virus disease, could have been a little more elaborated in view of its scientific, apart from local and economic, importance as the most typical and destructive virus disease of a forest tree. It is to be regretted that, no doubt the limitations of space could not also permit the author a broad survey of the source of the most important faunal causal organisms such as for instance Termes, Anobium, Xestobium and Teredo, etc. ("Deterioration of dead timber").

Two appendices deal with "Fungicides" and "A list of common names of plants used with scientific equivalents". The Index is compiled with American thoroughness.

The book is well got up and profusely illustrated. The hope modestly expressed by the author that the volume "will serve both as a text and a reference book" will be more than realised. S. A. K.

Brewing — Science and Practice. By H. Lloyd Hind. Vol. I.—Brewing Materials. (Chapman & Hall, Ltd., London), 1938. Pp. xiv + 505. Price 50*sh.* net.

The attempts made during the nineteenth century to understand the principles underlying the practice of brewing and redeem it from empiricism, yielded very valuable results. During the following years, the science of brewing became a "live" subject and attracted the attention of a large number of scientists with the result that the brewing industry has been, now, placed on a rigidly rational foundation.

There are several books in English which seek to give collected and classified information on one or the other aspects of brewing; the credit for producing a comprehensive treatise, emphasising the scientific principles of brewing, and at the same time proving useful to the practical brewer, goes to Lloyd Hind. The first volume is devoted to a discussion of brewing materials. Four chapters are set apart for a discussion of the structure, classification, physiological characters and composition of barley, the basic raw material of the brewing industry ever since man became acquainted with the virtues of beer. Barley has few rivals, although in countries where rice is abundant, that cereal has come to be looked upon as a substitute for barley. Three chapters are devoted to hops and three others to water. There are other sections devoted to the biochemistry of malt, brewing sugars, all ably presented. The task of bringing together in one volume both the theoretical and practical aspects of brewing, must have entailed considerable difficulties both of planning and presentation. The science of brewing buts into several specialised fields of research and the collection of all relevant matter must have necessarily involved considerable amount of library work. The outcome of all this labour is an eminently readable account of the chemistry and application of the raw materials of brewing.

The book will undoubtedly supply a long-felt want; it seeks to provide the practical man with sufficient scientific knowledge to make him intelligently appreciate the why and the wherefore of his processes. "Insist on maturity while selecting barely", "Select barley of low nitrogen content", etc., are commandments, which the brewer had long practised but whose rationale he will appreciate from a study of the facts properly marshalled and presented in the volume. A qualified chemist will, perhaps, find the scientific treatment rather elementary, but this is inevitable in a volume designed to meet the needs of the practical brewer. He will, however, find sufficient matter, in other parts of the book to interest him.

The book is well got up, and is free from errors. One error which came to the reviewer's notice appears in the description of *papain* (p. 171) where it is mentioned that the enzyme is active in neutral or alkaline solutions. This same error is found in

a few text-books on enzymes. Papain is hardly active in alkaline solutions; its range of activity lies in the region pH 4–6.

The appearance of the second volume, relating to Brewing Processes is eagerly awaited.

Experimental Methods in Gas Reactions. By A. Farkas and H. W. Melville. (Macmillan & Co., Ltd., London), 1939. Pp. xv + 389. Price 30*sh.* net.

The book has been written for the experimentalists by two experienced and distinguished experimentalists who have made many valuable contributions to the subject with which it deals. It has been written, as pointed out by Professor Rideal in his Foreword, 'with the object of providing the experimentalists with information of practical value, together with the relevant data not easily accessible', and its perusal reveals that this object has been achieved with conspicuous success. The authors have taken pains to see that nothing of practical value is left out and that there is sufficient amount of theory to minimise the gap between theory and practice. The inclusion of useful data and abundant references to original literature help to make the book a valuable work of reference on the experimental study of reactions in the gaseous phase.

It begins with a chapter on kinetic theory and chemical kinetics, which, besides summarising the principal formulæ, contains useful data about the dimensions, speed, collision frequencies and dissociation energies of important molecular species. This is followed by a chapter on the control of pressure and temperature, which gives a full account of the various devices employed for the production and measurement of pressure and temperature. Water-pumps, rotary oil pumps, and mercury diffusion pumps are described in detail, and a good deal of useful information concerning glass taps, glass cut-offs, greaseless valves, lubricants, greases, and metal-glass joints is included. Methods for the measurement of pressure and temperature are given in great detail, accompanied by neat illustrations of the apparatus and their arrangement. The next chapter is devoted to the methods of preparation and analysis (micro) of gases. The gases described include para-hydrogen deuterium and ortho-deuterium and the chapter closes with tables of vapour pressures.

An important feature of the book is a chapter on photo-chemical technique. In this chapter, a considerable amount of useful information regarding the sources of radiation, methods of measurement of radiation intensity, and the general arrangement of apparatus for photo-chemical investigations has been condensed in fifty pages. Extinction co-efficient of the more important gases serve as a useful guide to indicate the size and nature of the reaction vessel. A description of the photo-electric quantum counter is also included.

The last and the most important chapter of the book deals with the experimental methods for the investigation of chemical reactions, both thermal and photo-chemical. In this chapter, nothing of importance on the technical side has been omitted. The reaction vessels are described in detail and a full account is given of the methods of following the progress of reaction by measurements of pressure and thermal conductivity. Optical methods, including interferometry, polarimetry, spectroscopy and photometry are also mentioned. Full attention is paid to the measurement of the rate of reaction by flow methods, where the theoretical treatment is complicated by the effects of diffusion and convection, and the application of the method is illustrated by means of typical examples, such as the investigation of atomic reactions. A good deal of space is devoted to photo-chemical and explosive reactions, and to catalysts used in gaseous reaction.

A book of this type was badly needed and the authors must be thanked for having satisfied a long-felt need. It is hardly possible to overestimate its value as a book of reference for those engaged in the experimental investigations of gaseous reactions, and as a useful guide for those who wish to enter this field of research. It should find a place on the library shelves of every chemical laboratory where any kind of advanced work is being carried out.

The book is well produced. The only misprint noticed by the reviewer occurs on page 207, line 14, where there should be 'of' in place of 'and' after the word 'intensities'.

M. QURESHI.

A World Survey of Soil Erosion.*

THE Rape of the Earth was the title chosen by the authors, but was at first refused by the publishers as being too sensational and liable to disappoint a large public avid for thrills but not particularly interested in a work of soil erosion. When I met the authors at home last summer the match between themselves and the publishers was on, but apparently has since been settled in a victory for the authors, as their title has been accepted and used, though possibly it is the publishers who have introduced the less sensational sub-title of "A World Survey of Soil Erosion".

Both the authors are recognised authorities in their own particular spheres, Jacks as a soil chemist and Whyte as a grass-land ecologist, but it is a sign of the times that both should emphasise the social repercussions rather than the technical difficulties of introducing effective erosion control. We know roughly what are the agricultural, pastoral, forest and engineering principles which ought to be adopted to stop the present appalling waste of valuable top-soil but we cannot, or dare not, apply them forthwith on a scale commensurate with the gravity of the situation. "The problem of soil conservation is not solved merely by discovering the simple practices that will minimise erosion; when the right practices have been discovered, or, more correctly, when the need for adopting the practices has been recognised, the great task is to procure their general application."

In this connection it is interesting to read how in almost every country it is the method of land tenure which is proving the chief stumbling block to the introduction of organised control. No year-to-year occupier will spend labour or money on improvements. Tenant farmers all over the world, whether on a crop share or a cash basis, are forced through the very nature of their agreement with their landlord, to extract whatever they can from the soil, regardless of its ultimate productivity. The crop share is usually for edible crops, therefore the landlord does not encourage the tenant to grow the clovers and pasture plants which contribute something of good back into the soil. Short leases prevent the introduction of soil-improving crops or of a rotation of crops which will conserve the soil fertility. The common holding of waste land is in India and many other countries the root cause of deterioration because common land is "nobody's child" and is inevitably neglected.

The book rightly emphasises the ultimate dependence of all industrial and scientific development upon the welfare of the cultivator and the productivity of the soil. This is, or should be, transparently clear in India, which is essentially a land of villages. In the present enthusiasm for industrial development in India the fact is often overlooked that the purchasing power of the country in absorbing manufactured goods depends directly and almost solely upon the prosperity or poverty of the millions of villagers who either own and till their own land or rent that of a neighbouring owner. The authors blame the introduced methods of cultivation for the serious erosion in many of the "younger" countries, but in India the trouble is due to the indigenous agriculture, whose uneconomic practices combine with over-population to destroy the valuable top-soil, even on comparatively level lands.

According to General Smuts, quoted in this book, "erosion is the biggest problem confronting the country, bigger than any politics". If this can be said of South Africa where politics are a dominant and violently disruptive force, it can be equally safely said of India. Does it matter much to the Punjab whether it has a Unionist or a Congress Government if its main army recruiting grounds, namely the Jhelum Salt Range, the Hoshiarpur and Ambala Siwaliks, and the Rawalpindi foothills, are being reduced to a desert which will sustain neither man nor beast? Out of the many striking photographs showing phases of erosion in such far countries as Texas, Australia, Peru, the Lower Don of Russia, Nyasaland, Natal and Basutoland, most could be replaced by photographs of Indian conditions without either the authors or the landowners realising the deception.

As a study of contemporary scientific developments this book is invaluable and should be in the hands of everyone who has to do with the land and its manifold agricultural uses. The later and more spectacular phases

* *The Rape of the Earth*, by G. V. Jacks and R. O. Whyte. (Published by Faber and Faber, London), 1939. Pp. 312. Price 21*sh*.

of soil erosion have been subordinated in this study, and prime emphasis laid upon the *gradual loss of porosity* which is the most serious early symptom. This is accompanied by a loss of cohesion, and the insidious action of sheet-washing such as occurs on exposed fallow does its worst damage by destroying the *crumb structure*, that illusive but essential characteristic which is now coming to be recognised as of far more importance to soil fertility than any other single chemical or physical character.

In this connection the book gathers up the threads of contemporary research on the erodibility of both cultivated and uncultivated soils. It shows that this feature is only a relative term, because of the radical alterations which take place in the crumb structure of forest and grass-land soils whenever these are brought under cultivation. Each type of plant cover evolves a top-soil which is suitable to it; thus the coniferous forest builds up an almost structureless mass of light friable humus which is a permanent feature of the forest floor, but which disappears rapidly when the forest is felled and replaced by fields. The problem of the overfelling of private forests again brings forth a comparison of the United States with India, for in the Chota Nagpur plateau and the Hoshiarpur Siwaliks there is a crying need that the destructive tendencies of private ownership should be influenced by government control and advice. In South Africa the government is going in for the purchase of large areas of mountain land in the Union, the object being to check further abuses from over-grazing and the ploughing of steep slopes. Much of South Africa's most important catchment lies inside Basutoland, which is not under the Union Government, but here a 10-year programme of erosion control is being financed from the Colonial Development Fund by the Colonial Office, largely in order to help the Union.

Turning now to the authors' remarks on India, we read: "Over much of India the people have accepted a slowly deteriorating environment as part of the scheme of things; the vast majority is probably unaware that erosion is occurring". This is indeed an indictment which cannot be denied, but which ought to be taken up as a challenge. It is only by redoubling our efforts in educating the cultivator that we can alter this. The authors emphasise that the stabilisation of eroding lands cannot be effected by purely dictatorial legislation. The greatest recent advance in erosion control is the establishment by law of "conservation districts" in the U.S.A., where a majority vote of the farmers in an administrative unit can now form a district committee. This committee has very wide powers to coerce those who refuse to come into line with the experts' recommendations as laid down in their working scheme, which is more or less the forester's "working plan" of our Indian practice, but widened to make erosion control recommendations for every type of land in the vicinity. Starting in 1933 with demonstration projects scattered over most of the states, the Federal Government paved the way for this by educating the farmers in project areas to look after their own land, and the logical outcome is this delegation of authority to a local democratic body with powers to follow and enforce the experts' advice.

The authors frequently mention Java and the Dutch East Indies as having been saved from the erosion danger by the timely action of the Dutch Government, but from information gleaned during a visit last summer to their admirable Colonial Institute in Amsterdam, I gathered that the Dutch foresters and erosion experts were far from satisfied themselves over the rate of progress in counter-erosion work, particularly in the poorer soils of the more remote uplands. The fact remains, however, that the Dutch colonial organisation is fully alive to the danger, though it has not been mastered yet, except in the most intensively cultivated plantations which are under skilled European management.

A phase of soil conservation work which has not been sufficiently discussed in India, but to which the authors devote much space, is that of tree shelterbelts. The results of early tree belts planted in Russia are so satisfactory that the Soviet Government adopted a programme for establishing 865,000 acres of shelterbelts in their second Five-Year Plan. This compares in magnitude with the U.S.A. maximum of 1¼ million acres in 10 years for the Great Plains Shelterbelt project which is now going forward. In the Californian fruit districts shelterbelts are a *sine qua non* of good farming, and for orchard land it is considered worth while to have 10 per cent. of the area 15 dollars (40 rupees) per orchard acre under wind-break trees, and to spend up to

upon wind-break maintenance. Considering the recent large developments in Malta orange planting in the irrigated Punjab plains, it seems strange that this essential point in the Californian fruit-growing technique should have been neglected.

Amongst the many ways of checking erosion and reducing run-off from sloping lands, emphasis is rightly placed on *contour ridging*. In fact the authors harp so much on the need for terracing, trenching, and ridging at right angles to the slope of the land that they have coined a new phrase "contour farming" to cover the many minor variations of this standard principle in run-off control.

The book attempts to assess the wider implications of soil conservation activities throughout the world. In spite of the publicity which has focussed attention on this work in the U.S.A., the authors have decided that the African continent must now take the foreground for erosion "news value". In the U.S.A. a conservation economy is being developed on a vast scale and in an orderly manner, whereas in Africa the need for such work is even more urgent but the issue is much more complicated owing to the conflicting aims and interests of the several governments, the varying standards and needs of black and white populations, sometimes mixed, sometimes segregated, and the technical difficulties connected with the ecology of arid grass-lands and dry savannah forest. Due place is also given to the great effort now being made by Russia, for the Russian plan does not stop short with saving soil and stopping floods, but aims at a Utopia by harnessing all the rivers east and west of the Urals into a gigantic scheme for the conquest of the semi-arid steppes.

R. MACLAGAN GORRIE.

Electricity in Chemistry*

ALMOST the first application of electricity to chemistry was the experiment of Nicholson and Carlisle in which water was decomposed into its elements by a current from the voltaic pile, which had just then been discovered. This was in 1800. In the immediately following decades, the new tool of electricity held the fascination of the leading chemists. In particular, the classical work of Faraday and the laws enunciated by him have remained to this time fundamental in all considerations dealing with the relationships between electricity and chemistry.

Studies on these relationships increased rapidly, and when Arrhenius promulgated his hypothesis of ionisation equilibria in solutions, a definite big impetus was given to the whole subject. The thermodynamic study of energy in chemical systems had just then been initiated and was in the full vigour of its youth. It was soon realised that the electrical energy connected with galvanic cells was of a reversible type and that rigorous methods of thermodynamics could be applied to many of the chemical changes involved in the galvanic cells. The relationships between chemical and electrical energies, particularly in liquid systems, have since been developed by systematic work into a subject in itself, under the caption of "Electro-chemistry". This term 'electro-chemistry' can at the present day however comprehend a much wider range of topics, for, much of the recent investigations on the electrical nature of matter and of the chemical reactions between them, the investigations mostly carried out by physicists on the electrical conductivity in solids and gases, and several other aspects of molecular physics could all be included under this head. Indeed it will be difficult to draw any sharp line between "electro-chemistry" and other branches of physics and chemistry.

Still the old and somewhat arbitrarily defined 'electro-chemistry', which includes mostly studies of chemical reactions brought about by electrical energy and of chemical reactions giving rise to electrical energy, is itself a wide and steadily growing subject. Considerable progress has been made in this field after Debye and Huckel indicated how the then troublesome deviations of strong electrolytes from ideal behaviour in solutions, could be accounted for quantitatively by taking into consideration the interionic attractions and repulsions. As is well known the basic idea in this theory is that each ion is surrounded on the average by an

The Principles of Electrochemistry. By Duncan A. MacInnes. (Reinhold Publishing Corporation, New York, Chapman & Hall, Ltd., London), 1939. Pp. 478 with 148 illustrations. Price $ 6·00.

oppositely charged "ionic atmosphere" distributed with radial symmetry around the ion as centre. This concept besides its success in thermodynamics and potentiometry, has won laurels also in the field of conductometry. The ionic atmosphere gives rise to a retarding effect on the mobility of the ion, and this along with another effect pointed out by Onsager, as due to a finite time of relaxation between the ion and its atmosphere, is able to successfully account for the observed equivalent conductance of solutions of strong electrolytes at least over the range of low and moderate concentrations. Other consequences of the Debye and Huckel theory such as the Wien effect at high field strengths, and the dispersion effect at high frequencies have been predicted and verified. All these new ideas and theories have brought in their wake, considerable improvements in the technique of electrical measurement on solutions.

As regards practical applications, the principles of electro-chemistry have been utilised from the earliest days in the arts of electro-plating, electro-metallurgy, etc., while indirectly they have been of even greater use in the control of industrial processes, through conductivity, pH and E.M.F. determinations. On the fundamental side, electro-chemistry has provided some powerful tools in investigations relating to chemical reactions involving strong electrolytes, the nature of molecular complexes, hydrolysis and solubility of substances from conductometric measurements, studies on the course of reactions from potentiometric and conductometric titrations, the analysis of proteins from electrophoretic studies as developed by A. Tiselius, etc.

Among the leading contributors to this renaissance in electro-chemistry, Dr. MacInnes is a prominent figure. The work of MacInnes and his associates is characterised throughout by systematic attempts to improve the accuracy of experimental data, and they have achieved many significant successes in verifying the predictions of the interionic attraction theory with respect to activity coefficients, conductivity, etc. The book itself which Dr. MacInnes is now presenting to the scientific world can rightly be described as another and fundamental contribution to the science of electro-chemistry. It breathes of precision throughout: the experimental portions described deal with the modern refinements of technique while the theories are clearly and succinctly recounted by leading up from first principles wherever possible. Ample references to the original literature, most of them of recent dates, have been provided to help the reader further on. In many ways a marked and very welcome feature of the book, is the careful, painstaking and critical evaluation of the available experimental data, and of the derived physical constants. The result is, that for the field covered the book takes a front rank with other critical compilations of data on physical constants. There is, besides, a logical development of ideas, the scope of the book being extended in the last five chapters to the use of conductance measurements in various physico-chemical investigations, the effect of structure and substitution on the ionisation constants of organic acids and bases, the dielectric constants of liquids and the dipole moments of molecules, electrokinetic phenomena, passivity and overvoltage.

There is but little to offer by way of helpful criticism, as it is patent that the book has been brought out with much painstaking care and with clearly defined objectives. However, a few illustrative problems either as an appendix at the end of the book, or at the end of the relevant chapters would have added to the usefulness of this book. As a work of reference to all, it is almost a necessity.

M. A. G. RAU.

INDUSTRIAL SECTION

Semi-Automatic Cell Testing Device for Dry Cells

By L. C. Verman and G. D. Joglekar

(*Industrial Research Bureau, New Delhi*)

THE heavy intermittent discharge test for dry cells of the DU2 type (1¼" diameter × $2\frac{3}{16}$" height), as laid down in British Standards Specification No. 397 of 1933, requires that each cell should be discharged through an external resistance of 5 ohms for three hours per week, with not more than thirty minutes continuous discharge per day. The discharge is to be continued until the potential difference between the terminals, measured at the end of a day's run with the test current flowing and by means of a high resistance voltmeter, has fallen to 0·75 volt per cell, when it shall be deemed to have completed its life. This testing procedure requires that a considerable period of time elapses before the electrical characteristics of the cells can be determined. During the course of the research work which has been in progress at the Government Test House in connection with problems of dry cell manufacture, it was felt that progress could be accelerated if the results of a given set of experiments were quickly made available, so that they could be used to guide further experiments. It was therefore necessary to reduce the testing period without materially changing the testing procedure or appreciably affecting the output results.

The acceleration of the testing procedure was effected by discharging the cells twice a day for half an hour each time instead of once a day as required by the B.S. Specification. In order to conduct both the discharges during the working period of the day, the intervals between successive discharges had to be fixed at 6 and 18 hours. This, however, was far from ideal, for the recuperation period of the cells was thus cut down from 24 hours to 6 hours for alternate discharges. An equal division of the 24-hour period into two 12-hour periods would have been much more desirable. This necessitated an automatic device for effecting and controlling the discharges during hours when the laboratories are normally closed. Such a device was designed and has been in operation for some time. It is briefly described in this paper in the hope that it may prove useful to other workers in this field.

Description

The device comprises a wall clock controlling a set of relays which operate a solenoid fitted with a plunger connected through a mechanical tilting device to two banks of sixty mercury tube switches, the banks being disposed at right angles to each other on a triangular corner-table. Each of these switches is connected in an individual dry cell circuit. Figs. 1 and 2 show photographs of the complete device, Fig. 3 gives the circuit diagram of the test circuits, and Fig. 4 shows the circuit diagram of the control circuit.

In Fig. 1 is shown the controlling clock,

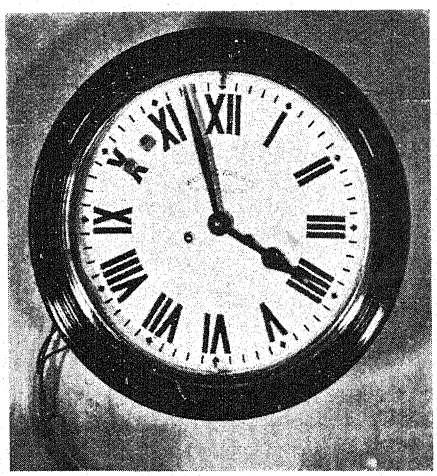


FIG. 1

on the dial of which four insulated platinum contacts are mounted. Two of these contacts make contact with the tip of the hour hand and the other two with the tip of the minute hand. The hour hand contacts are mounted at 10:00 o'clock and 10:30 o'clock positions, while the minute hand contacts are at 12:00 o'clock and 6:00 o'clock positions. Thus at 10:00 o'clock an electrical circuit is closed through the hour hand and the minute hand, while at 10: 30 o'clock another circuit is closed through the same channel. Furthermore, at no other time of the day can either of the circuits possibly close. Thus at 10: 00 o'clock twice a day,

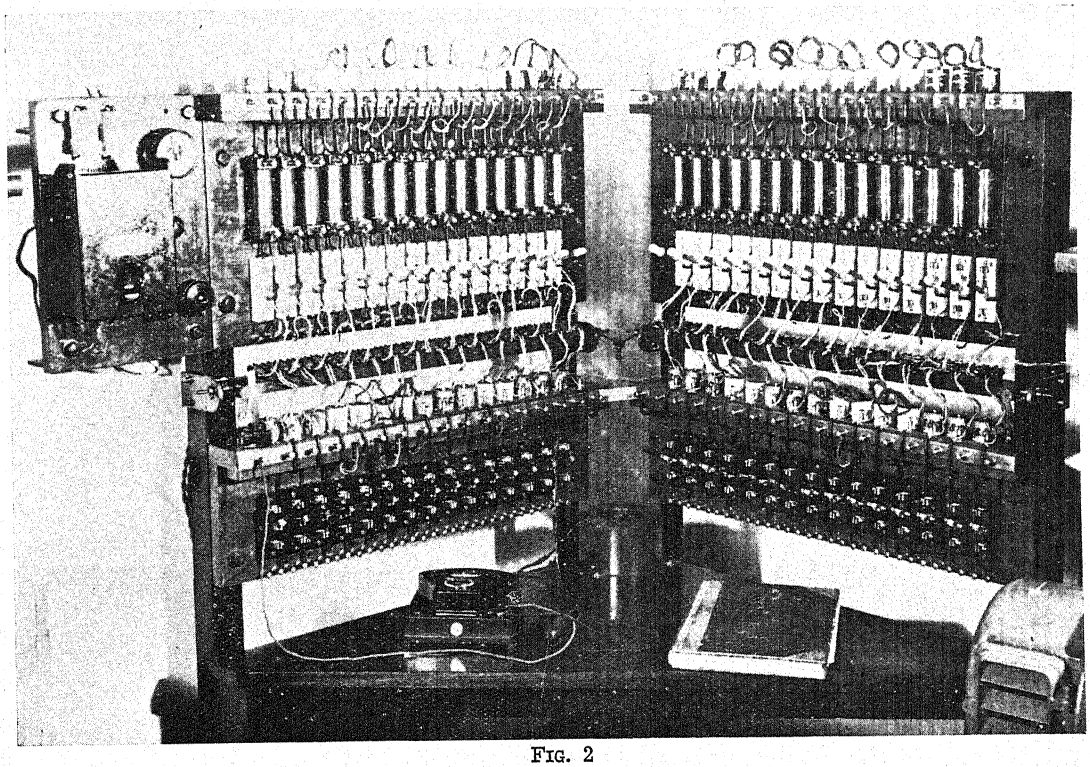


FIG. 2

the closing of the first circuit turns on the cells under test, and at 10: 30 o'clock the cells circuits are opened. In order, however, to take voltage readings from day to day, the automatic device is allowed to act only

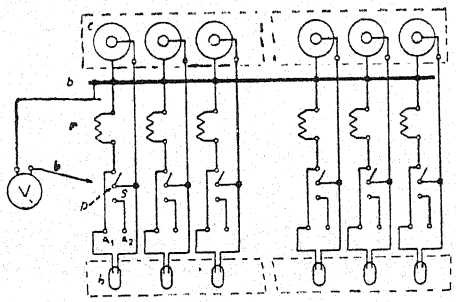


FIG. 3

Circuit Diagram of the Test Circuit

c–Dry cells; *b*–Busbar; *r*–5 ohm fixed resistances; *s*–S.P.D.T. knife switches; *p*–Terminals for voltage measurements; A_1 A_2–Ammeter terminals; *h*–Mercury tube switches; *i*–Wandering voltmeter lead; *V*–High resistance voltmeter.

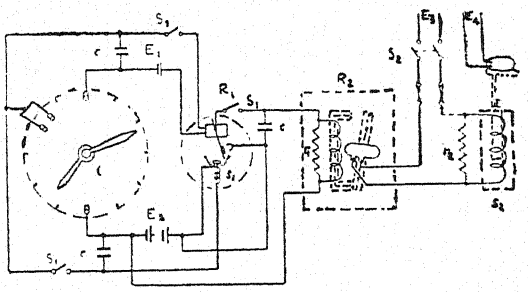


FIG. 4

Circuit Diagram of the Control Circuit

C–Clock; R_1–Sensitive relay; R_2–Power relay; S_1–S.P.S.T. switches; S_2–D.P.S.T. switch; E_1–1·5 volts D.C.; E_2–6 volts D.C.; E_3–220 volts D.C.; E_4–1·5 volts test cell voltage; r_1–Discharge resistance; r_2–Discharge resistance; *c*–1 μf Condensers; s_1–Sensitive relay solenoid; s_2–Tilting solenoid.

once a day in the evening, while in the morning, the device is cut out and manual discharges are carried out for which duplicate switches are provided.

The control circuit operated by the clock shown in Fig. 4 comprises a sensitive relay R_1, power relay R_2, and the tilting solenoid s_2.

The closing of the sensitive relay circuit at 10:00 o'clock through the clock contacts operates the power relay, which energises the solenoid and tilts the two banks of mercury switches shown in Fig. 2. The sensitive relay contacts are held closed, because one of them is a permanent magnet, while the other one has an iron rider. At 10:30 o'clock, when the second circuit is closed by the clock contacts, a solenoid marked s_1 (Fig. 4) is energised and draws the sensitive relay contacts apart and thus de-energises the tilting solenoid. The two banks of mercury switches are then tilted back to the open position by the two springs provided.

The sensitive relay and the power relay are Weston relays, model 705 (solenoid reset type) and model 630 respectively. The solenoid s_2 is wound on a brass tube of ⅞" inside diameter by 2½" long with 19,000 turns of No. 30 S.W.G. double silk-covered copper wire, each layer of the winding being treated with a thick solution of shellac during the course of winding. The solenoid is enclosed in an iron body leaving an opening 3" in diameter at the top. On each bank of the tilting device thirty mercury switches are mounted, adjustment being provided for the tilting angle. Two strong springs hold the switches normally in the open position against which the solenoid pulls.

The details of the cell testing circuits are shown in Fig. 3. A double-throw single-pole knife switch is provided in each circuit, one side of which is paralleled to the mercury switch, while the other side is so connected that the discharge current may be read by connecting an ammeter to the terminals A_1, A_2. Short leads are soldered on to the terminals of the cells under test which are placed in cell receptacles. One of the leads of each cell is connected to a common bus-bar, while the other is connected to an independent terminal belonging to its own individual circuit. For manual testing, switches S_1 and S_2 (Fig. 4) are turned off and knife switches s (Fig. 3) are made use of, the voltage readings being taken between the common bus-bar terminal and the terminal marked p (Fig. 3) of the individual circuits.

In order to ascertain whether the device has functioned properly during the night, a strip of blotting paper is attached to the rack carrying the mercury switches and a pool of ink is placed under it just out of contact. When the switch banks tilt, the paper dips in the ink, and the height to which the ink rises indicates approximately the time duration for which the mercury switches were turned on during the night.

Testing of Cells

It is known that the output characteristics of cells are affected by the temperature and the humidity of the surrounding atmosphere. With a view to avoiding the effects of variation of atmospheric conditions, the testing unit is placed in an air-conditioned room, the temperature of which is maintained at 80° F. and the relative humidity at 70 per cent.

The dry cells under test are now being discharged at 10 o'clock twice a day except on Saturdays and Sundays. On Saturdays the cells are discharged only once a day in the morning and on Sundays no discharge takes place. Thus eleven discharges per week are obtained instead of six as provided by the specification mentioned above.

The watt-hour output capacity of cells obtained under double discharge conditions by means of the automatic device is naturally less than that obtained under the B.S. Specification conditions of testing, due to the smaller recuperation period permitted by the former. With a view to determining this loss in capacity a number of cells of four reputable makes were tested in parallel by the two procedures.

The cells were subjected to internal resistance and polarisation tests before putting them on life test. The polarisation tests, though not recommended by the B.S. Specification for this type of cell, was undertaken with a view to obtaining a complete record of the performance of the cells. With the automatic device, voltage readings were taken only once a day in the morning, the average values of the discharge voltages for the night discharges being taken as the average of the two successive morning discharges. The end point of the life test, if occurring during the night discharge, was similarly determined.

The watt-hour output was calculated according to the method given in the B.S. Specification. The power used during the polarisation test was added to the above figure to obtain the total watt-hour output of the cells. The watt-hour output obtained by these two methods of testing, and also the other characteristics, are given in Table I.

TABLE I

Comparative Output Figures obtained by the two methods of testing

Test No.	Laboratory designation of the make of cells	No. of cells tested	Testing method	No. of discharges per week	No. of days required to complete the test	Average characteristics				Increase in W.H. capacity obtained with the B.S. Specification method %
						Initial open circuit voltage	Internal resistance ohms	Polarisation %	Output W.H.	
1	A	3	B.S.S.	6	34	1·56	0·205	17·15	4·13	22·9
2	A	3	Automatic	11	16	1·56	0·215	17·15	3·36	
3	B	3	B.S.S.	6	25	1·56	0·225	21·59	2·57	16·3
4	B	3	Automatic	11	15	1·56	0·250	21·05	2·21	
5	C	4	B.S.S.	6	26	1·56	0·200	21·40	2·90	17·4
6	C	6	Automatic	11	16	1·56	0·215	21·85	2·47	
7	D	6	B.S.S.	6	31	1·56	0·230	17·90	3·25	20·4
8	D	6	Automatic	11	12	1·56	0·230	17·90	2·70	

Average = 19·3

In the last column of this table is given the percentage by which the output obtained by the double-discharge method, using the automatic device, has to be increased in order to calculate the output obtainable if the B.S Specification method had been used. This correction varies between 16 and 23 per cent., giving an average of 19·3 per cent. In practice, therefore, the output of experimental cells obtained by double-discharge method, using the automatic device, requires to be increased by this factor in order to estimate the probable value which might have been obtained by the B.S. Specification method. The probable error of this estimation will be less than 3 per cent., which is very small compared with the normal variations that occur from cell to cell. Table I also shows the saving in time effected by the use of the double-discharge method, which on the average amounts to about 50 per cent. This saving in time, besides making the results of experiments available in a shorter period, virtually doubles the capacity of the testing equipment, thereby enabling twice as many cells to be tested in a given period of time.

The device as it stands has been designed to test dry cells under certain particular conditions. It may, however, be modified at will to give any desired cycle of switching operations involving different timing for on and off intervals.

Indian Science Congress, 1940

THE Twenty-seventh Annual Meeting of the Indian Science Congress will be held in Madras from January 2nd to 8th, 1940. His Excellency John Francis Ashley, Lord Erskine, G.C.I.E., Governor of Madras, has consented to be the Patron of the Meeting. Professor B. Sahni, M.A., SC.D., F.N.I., F.R.S., Professor of Botony, University of Lucknow, will be President.

Intending members are requested to send their subscriptions to the Congress, to the Treasurer, Indian Science Congress Association, 92, Upper Circular Road, Calcutta.

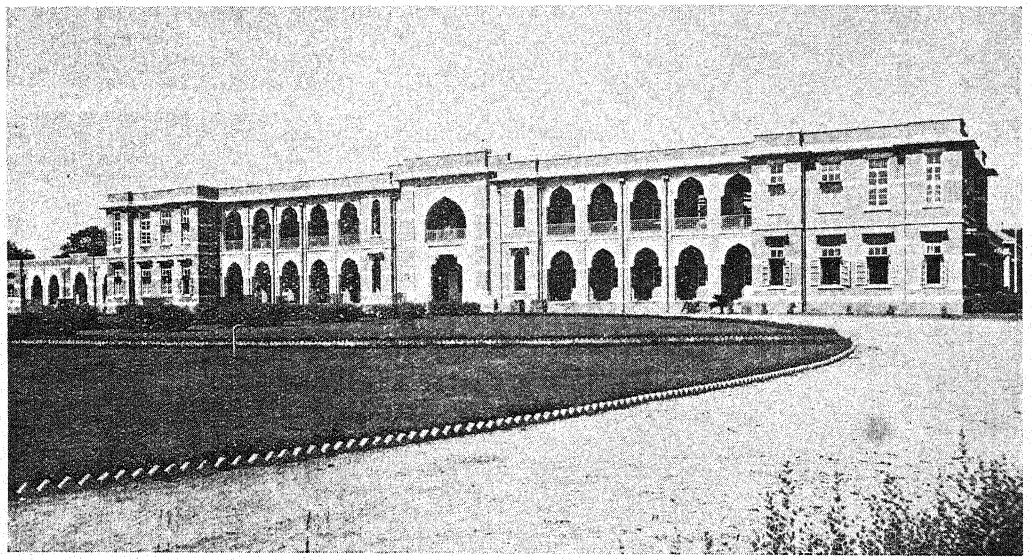
Papers intended for being read at the session should be forwarded together with three copies of an abstract *so as to reach the General Secretary, mentioning the Section, before which the paper is intended to be read, not later than September 15th,* 1939. Abstracts should be typewritten and must not exceed 200 words. They should not include formulæ or diagrams.

No abstracts will be printed unless accompanied by the full paper at the time of submission.

Rao Bahadur A. Lakshmanaswami Mudaliyar, B.A., M.D., F.C.O.G., Principal, Madras Medical College, Madras, and Sri. R. Gopala Aiyar, M.A., L.T., M.SC., Director, University Zoology Research Laboratory, Madras, are the Local Secretaries of the Session.

Shree Sayaji Jubilee Science Institute

WITH the increasing expansion of the activities of the Science Department of the State College, the Government of His Late Highness The Maharaja Gaekwad of Baroda, felt a pressing need to accommodate the science departments of the College in a separate building. At the same time, the Government felt that it was time that a definite step was taken for the Industrial Development in the State, not only to strengthen the existing industries but also to start new ones. Both these objects, it was felt, could be achieved by locating the various science departments of the College in a separate building with an annexe for the Applied Chemistry Laboratories.



Shree Sayaji Jubilee Science Institute

To commemorate the Diamond Jubilee of Sixty Years' Reign of His Late Highness, Sir Sayajirao Gaekwad, Maharaja of Baroda, several industrialists and philanthropists came forward to make contributions towards the building of the proposed Institute, which is now named "The Shree Sayaji Jubilee Science Institute" as a monument to the memory of His Late Highness, and in deep appreciation of the forward policy of His Highness' Government to help industries, agriculture, public health, etc. The needs of the several departments of the State were ascertained by the Government and proper provision was ordered to be made for locating the several laboratories in the technological wing of the Science Institute. The Sayaji Jubilee Science Institute was formally opened by His Excellency the Viceroy, Lord Willingdon, in January 1936. In this Institute full provision is made not only for undergraduate teaching but also for post-graduate research in each of the science departments, *viz.*, chemistry, physics, botany and zoology. In the Technological Research wing, research laboratories for the investigation of industrial problems, problems of agriculture specially those relating to soil, water and crops, and for the examination of food-stuffs are housed. In it are also located the laboratories of the Agricultural Chemist to the Government, of the Industrial Chemist to the Government and of the Public Health Analyst. Provision has also been made for accommodating the Excise Laboratories of the Government. All these laboratories have a common Library. Industrial research is now being carried out at the Technological Institute in collaboration with the Kalabhavan Technical Institute. The Research chemists attached to the Baroda College Chemistry Department, the Technological Wing of the Institute, the Chemistry Department of the Kalabhavan and Alembic Chemical Works, Ltd., are working in close consultation and collaboration. The planning of the scientific activities of the State has tended to minimise expense and yet secure maximum benefit to the Government and the public.

The Industrial Research Section is carrying out the analysis of a variety of products such as type-metal, ink, starch, soap, waters, different types of ores, industrial raw materials, textile auxiliaries, etc., both for the Government Departments and the Industries in the State. It has evolved out a standard composition for the type-metal, which is utilised for the manufacture of the types at the Baroda State Press Foundry at almost half the market price. It helps the textile industry by handling its problems in sizing and finishing of cloth,

analysing raw materials, auxiliaries, boiler feed waters and rendering suitable advice. It also advises the Public Health Department on problems connected with water supply and food materials. It has investigated the conditions of manufacture of "lime washes" from China clay and has rendered immense help to small manufacturers by giving advice and guidance whenever these were sought. The research section is at present engaged in studying (*i*) the polymerisation of Indian vegetable oils with a view to their utilization in the manufacture of patent leather, book binding leather, etc., and also (*ii*) the sulphonation of the same oils with a view to their utilisation as textile auxiliaries as wetting out, emulsifying and cleansing agents in textile industry. These investigations have been allotted to the Institute by the Industrial Research Bureau, New Delhi. The possibilities of manufacture of ultramarine, water-glass and the whitening of China clay of Ransipur Mines, are now under investigation.

The Agricultural Chemists' Laboratory was a long-felt want in the State. His Late Highness, as far back as 1912, expressed his desire that the chemical analysis of the soils of the State should be undertaken by the Agricultural Department. With the establishment of the Sayaji Jubilee Science Institute, this hope was realised and the Agriculture Department now possesses a well-equipped chemical laboratory.

Among the problems that are being investigated in this section, mention may be made of the following:—(1) Effect of small doses of potassium nitrate on the growth and quality of tobacco. (2) Studies in Electroculture: Effect on soils and on composition of the plants. (3) Growth of different varieties of cotton on typical State soils, and (4) Composition and nutritive value of *Trichosanthus diocea*.

The Public Health Laboratories, which were equipped in January last, have started work on the Grading of Ghee on the same lines as those carried out under the Agricultural Marketing Advisor to the Government of India. These laboratories are now equipped for carrying out the analysis of food materials such as milk, tea, coffee, flours, etc., with a view to detect adulteration. The laboratories are so designed that if and when the Food and Drugs Act comes into operation, space will be available for additional equipment to cope with all the work in that direction.

It is proposed to house the Excise Laboratories in the same building. These laboratories will undertake the analysis of spirituous preparations with a view to determine the excise duties to be levied on such preparations. The laboratories will be adequately equipped to meet the exacting requirements of the British Government and to enable spirituous medicinal preparations manufactured in the State to pass through the customs on the strength of the analytical reports of the Science Institute. The Sayaji Jubilee Science Institute thus embodies a unification of scientific efforts in research, both pure and applied. It is needless to state that the Government of Baroda deserve warm congratulations from the public for such a sound forward policy.

ASTRONOMICAL NOTES

Planets during August 1939.—Mercury will be in inferior conjunction with the Sun on August 10 and will afterwards become a morning star. Venus continues to be close to the Sun and is not in a favourable position for observation during the month. Mars which is in opposition to the Sun on July 23, will be a conspicuous object in the eastern sky, immediately after sunset; it is however getting fainter, its stellar magnitude decreasing to −1·8 at the end of the month. On August 24, the planet will be at one of the stationary points of its geocentric orbit.

Both Jupiter and Saturn can be conveniently observed in the latter part of the night. The latter will be stationary on August 15 and will be seen on the meridian about an hour before sunrise. Uranus continues to move slowly eastwards in the constellation Aries until August 28, when it becomes stationary. On August 9, the planet will be in close conjunction with the moon.

Comets.—Pons-Winnecke Comet has, as predicted, become brighter, an observation of June 12 showing its magnitude to be 8·5. Information has been received of the discovery of a new object by Jackson at Johannesburgh, which, later on was found identical with comet 1925 II. Schwassmann Wachmann (*U.A.I. Circ.*, 777). At the time of discovery it was a faint object of the 13th magnitude, but it is receding from the earth and becoming fainter.

Perseid Meteors.—The Perseid showers, one of the principal meteoric showers, will occur on August 10–12; the position of the radiant point is R.A. $3^h\ 0^m$; Declination 57° N. in the constellation Perseus.

A Supernova.—In a photograph of the elliptical nebula N.G.C. 4621, taken at Mt. Palomar, Zwicky has found a new object of magnitude 15 (*U.A.I. Circ.*, 774). Spectrographic observations at Mt. Wilson have shown that the object is a supernova about three weeks past maximum. The nebula is a member of the Virgo cluster of galaxies.

T. P. B.

Development of Electrical Industry in India*

ELECTRICITY, in recent years, has become the basis of national economy in industrial countries. A comparison between the indices of electricity production and earning capacity of the people indicate the great rôle that is played by power industry in the economic prosperity of a country.

Electrical supply industry in India has progressed slowly during the past. Recently, however, attempts are being made in many Provinces and States to rationalise the supply industry and centralise, as far as possible, power generation. There is no co-ordination established, so far, between various development authorities. The technical and commercial experience of other countries show that there is a vital need for such co-operation if the country is to exploit to the full, its natural advantages. Electrical manufacturing industry in this country is also of recent origin and is making slow progress. The only manufacturing activities worth mentioning are those of the Indian Cable Co., Jamshedpur; the lamp factories at Bombay, Calcutta, Agra and Bangalore; the transformer winding section of the Government of Mysore; the porcelain insulators (up to 11 K.V.) manufactured at Bangalore, Bengal, etc.; small workshops manufacturing A.C. or D.C. fans, heaters, torchlight casings, dry cells, accumulators, etc., radio repair shops which have recently sprung up in big cities like Calcutta and Bombay, and the Government telegraph workshop at Calcutta. The Indian Electrical Market is mostly in the hands of foreign manufacturers.

Technical research, on which electrical manufacturing industry has to depend for its economic existence in the international field, forms one of the main considerations of the industry to-day which is spending millions of pounds in research. This progress is so rapid that the rate of obsolescence to-day has surpassed depreciation of both the manufacturing equipment as well as manufactured goods, so that the industry is still in fluid condition and no manufacturer can hope to survive unless he has adequate means to keep himself in a line with this progress.

Based on these and other considerations the following tentative plan for the creation of a "Central Electricity Development Board", representing the Central and Provincial Governments and other electrical interests in the country, has been put forward.

The function of the Board should be firstly to co-ordinate, develop, guide and integrate, to the extent possible, the supply industry in the country; secondly to stimulate and guide the proper formation and co-ordinate the policy and efforts of the manufacturing industries to be started. With these aims in view the Board should be empowered.

1. To organise at the centre (*a*) technical and research; (*b*) commercial and statistical, services under its control.
2. To devise legislation for the formation of Central Financial Trust to work in co-operaton with the Board.
3. To develop suitable trade relations with foreign firms with a view to start manufacturing industry in India with their co-operation.
4. To organise Indian technical education and services in co-operation with Indian educational centres and manufacturing firms in this country and abroad.
5. To devise legislation, in proper course of time, relating to such matters as general supervision, protective tariffs, standard specifications, electricity rates, relations with consumers, electrical prices, etc., which are essential for the healthy development of the industry.

It may be suggested that in general the main monetary burden of a supply scheme should be shouldered, as it is done to-day, by the Government of the Province in which the scheme is located whereas the major portion of the capital required for financing a manufacturing concern should come from private sources. The Central Trust would thus be relieved of a major responsibility, and can depend upon the initiative of Provincial Governments and private industrialists to make a success of an undertaking. The sharing of capitalization by foreign firms whose aid is essential, at least in technical matters will have to be considered in this connection.

The provincial electrical engineering departments should maintain the necessary services to work in co-ordination with the Central Organization. Provincial surveys relating to power and other resources, potentialities of load development, connections with local industrialists, commercial propaganda, and such other matters, should be left to the Provincial Departments.

Potentialities of electricity in a country cannot be assessed merely from the immediate profit-earning capacity of the electrical industry. In a general programme of industrial regeneration of a nation the part played by power and implements of cheap production claim equal attention. Judged from this point there is a wide field for electricity to grow in this country. At this stage, therefore, what is necessary is a guiding hand that would rally the scattered resources of the country, guide them into proper channels and bring about a proper co-ordination between this basic industry on one hand and all the productive industries on the other, to the mutual benefit of both and to the general prosperity of the country.

* Based on the report on the "Development of Electrical Industry in India" submitted recently to the National Planning Committee, from the Department of Electrical Technology, Indian Institute of Science, Bangalore.

Experiments on the Cold Storage of Mangoes and Other Fruits and of Vegetables

ONE of the most important schemes, judged both by its applicability to the whole of India and by the promise of its commercial possibilities, relates to the Cold Storage experiments started by the Imperial Council of Agricultural Research in Kirkee near Poona. Begun in the year 1934 these experiments have now been in progress for about five years and the results obtained so far have been embodied in two separate publications of the Council, *viz.*, *Miscellaneous Bulletins* Nos. 21 and 23, on "Mangoes" and "on Fruits and Vegetables" respectively. The cold storage plant employed in these experiments consists of an ammonia compressor, with evaporating coils cooling down brine which circulates in the different chambers. Seven such chambers, all operated automatically with regard to the regulation of temperature and designed to work with seven different temperatures, which in these experiments were 30, 35, 40, 45, 52, 60 and 68 degrees Fahrenheit, comprise the arrangement. Some 28 different varieties of mangoes from the provinces of Madras, Bihar, the U.P. and Bombay were subjected to the trials. The results of these trials have established that fresh fruit, *i.e.*, "green in colour and mature" can keep well for about seven weeks when held at 45° F. and that that is about the best temperature, all factors considered, that the Alphonso variety was found the best "keeper", that an interval of two days after picking from the trees makes no difference from freshly picked fruit in regard to keeping up to seven weeks, and that the cold stored fruit kept well and ripened normally when taken out and kept at room temperature, *i.e.*, 80–96° up to a week after such removal. Among the Madras varieties Peter appeared to be the best, its storage life being, however only four weeks. The Bihar and U.P. varieties were all poor as regards suitability for storage; it must be remembered that these fruits from long distances had suffered from the conditions of railway transport in the heat of the summer and under better conditions may perhaps behave differently. The wrapping of the fruit before being put in cold storage was found decidedly undesirable, far from its being of any advantage as might be supposed. Likewise fruit kept best when packing materials like rice straw, wood-wool, saw-dust, mango leaves, etc., were not used; only the bare minimum of such material that may be required to keep the fruits in position in the crates is recommended.

Among other fruits, the work on oranges is certainly the most important. Santra oranges from Nagpur and Malta oranges from the Punjab were the two kinds tried, and the latter was found superior to the former in respect of keeping. The fruits have to be ripe and yellow in colour, and at this stage the Maltas keep for four months and the Nagpurs for three months, held at 40° F. As with mangoes pre-storage treatment such as wrapping in paper or washing with antiseptics proved of no advantage. Other fruits tried were bananas, chikoo, litchi, apples, lemons and among vegetables potatoes, cabbage, cauliflower, French beans, peas, carrots and onions. All have lent themselves to keeping under cold storage for varying periods with the exception of the cauliflower which did not keep even for a week. Potatoes behave remarkably well; at 35° F. seed potatoes remained in dormant condition for about a whole year, with their germinating power unimpaired even after ten months of such storage.

Elsewhere we read that practical action with regard to arrangements for exporting Indian fruits to overseas markets and for providing cold storage facilities in inland railway transport awaits the results of these experiments. It may now be hoped that such action may soon be taken by the Central Government. The results deserve also to be made more widely known among people connected with the trade in mangoes and other fruits so that private enterprise may take advantage of the results in order to widen the markets for these fruits and vegetables and to lengthen the season for these fruits, so to speak, by avoiding gluts and by assuring an even supply. A. K. Y.

Museums Association for India

THE question of the establishment of a **Museums Association** for India was considered by the Museums Conference held at Delhi in 1937 and the Conference resolved that a Central Committee should, as a preliminary, be appointed to consider ways and means of bringing the proposed Association into being. This Central Committee was to consist of seven people, among them being the Director of the Archæological Survey of India, the Director of the Zoological Survey of India and the Director of the Art Museum at Baroda with Mr. S. H. Prater, Curator, Bombay Natural History Society, as Honorary Secretary. Besides the formation of a Museums Association the object of this Central Committee would be the improvement of the standard of Museums and Museum work in this country and to provide a permanent focus of co-ordination and co-operation which is essential to the purpose. The total absence of such co-ordination in India or the means to effect it is deplored by the Markhan Report. Conferences of Museum officials, held under the ægis of the Government of India in the past, have urged the importance and necessity for a permanent Standing Committee on Museums in India. The recent Conference of Curators in Delhi, during the very

brief period it was in session, was unable to give sufficient time and consideration to the various problems affecting Museums in India. It was the unanimous opinion of those present that various questions relative to the training and qualifications of Curators, the co-operation necessary to this end, the improvement and extension of the services of Museums to the nation, the elimination of unnecessary overlapping and duplication of effort, the solution of many problems with which Museums in this country are confronted and the removal of disabilities under which they suffer were all matters which could be considered with greater advantage by a permanent body. An organisation such as is contemplated would prove of great encouragement and helpful assistance particularly to smaller museums which are now struggling under difficulties with little expert knowledge to guide them. It will also provide a body to which those contemplating the establishment of Museums or Art Galleries can look to for guidance and it will be able to express authoritative opinion on matters relating to such institutions.

It is clear that without a permanent organisation for focussing and continuing effort, the work of periodic conferences of Curators would be largely ephemeral. It is unnecessary further to emphasise the need of such an organisation or to indicate the contribution it could make to the progress of Museums in this country. The cost of maintaining a Standing Committee would in the initial stages entail the salary of a clerk, the cost of postage and stationery; there would also be the question of travelling and halting allowances to the members of the Committee for attending meetings arranged periodically at various centres in India.

Resolution 4 of the Conference recommended that the cost of maintaining the Standing Committee should be borne by the Government of India. It is understood that the Government of India have approached the various Provincial Governments and States with a view to ascertaining how far they would be prepared to contribute towards the maintenance of a permanent Standing Committee. The establishment of the Central Standing Committee should be the preliminary to the forming of a Museums Association and the question as to whether this Committee will function is dependent on the various Governments and States concerned providing for its upkeep.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

O'Callaghan, Francis Langford (1839–1909)

FRANCIS LANGFORD O'CALLAGHAN, an Irish Indian Engineer, was born at Cork, July 22, 1839. Having been educated at Queen's College, Cork, he received his training in engineering between 1859 and 1862, when he was employed in railway construction in Ireland and South Wales. In 1862 he entered the Public Works Department of India by competitive examination. He steadily went up the cadre until he reached the top-position of Secretary to the Public Works Department, from which post he retired in 1894.

His Chief Constructions

He built the bridge across the Indus at Attock. This earned for him a C.I.E. He designed and partly constructed the railway through the Khoja Pass to the Afghanistan frontier. He also built the railway line to Quetta. This earned him a C.S.I.

On his retirement, the Colonial Office appointed him managing member of the Uganda Railway Commission. His services in connection with this undertaking were rewarded in 1902 with the K.C.M.G.

O'Callaghan died suddenly, November 14, 1909.

Balbach, Edward (1839–1910)

EDWARD BALBACH, an American metallurgist, was born in Karlsruhe, Baden, Germany, July 4, 1839. His father, who was engaged in the smelting and refining of metals, migrated to America with his son and opened at Newark, the centre of extensive jewellery manufacture, a business for the treatment of jewellers' sweepings, which formerly had been sent to Europe. This business steadily grew and was extended to the general metallurgy of silver-lead ores. Young Balbach began to help in the growing business in his fourteenth year. He was admitted a partner in 1864.

Balbach Process

From 1859, large consignments of silver-lead ore came for smelting and refinement. The methods for treating this material were both expensive and inadequate. But in 1864, Balbach introduced a great improvement in the desilverizing process, which revolutionised the methods. The process came to be known as the Balbach Process. Balbach also made many improvements, as for instance, retorting furnaces, tilting furnaces and the utilisation of water-jackets.

Electrolysis of Copper

Another notable achievement of Balbach was in 1881 when he built the first commercial plant in America for the refining of copper by electrolysis, laying the foundation for the position America reached in the business in later years.

His Qualities

His inventive genius was coupled with a practical bent of mind. He studied and learned the business from the botton up, with a tireless energy and zeal. His presence at his post both early and late set a constant and good example to the younger generation.

Balbach died of pneumonia December 30, 1910.

SCIENCE NOTES AND NEWS

Daguerre's Discovery.—Photography has become so common to-day that it is difficult to realise the excitement its discovery caused. It was 100 years ago on January 7, 1839, that M. Arago announced to a meeting of the *French Academy of Sciences* (Applied Physics Section), the epoch-making discovery of M. Daguerre. The capturing or fixation of the vivid images made by the camera obscura or dark room was a goal long sought. Previous attempts at using layers of photo-sensitive salts like AgCl had proved quite unsatisfactory and the invention of Daguerre was hailed with enthusiasm by a Committee of the Academy consisting of Hunmbolt, Biot and Arago. Three of Daguerre's best results were exhibited in the Great Gallery adjoining the Louvre and the Tuileries, and a request was sent to the Council of Ministers for an adequate recompense for this discovery which was a product of several years' hard work.

It is interesting to note that at this very first announcement of the discovery, the value of photography as a precious tool for new investigations in physics and astronomy was fully realised and a picture of the moon was taken by M. Daguerre himself at the request of the Academy.

* * *

A relatively new technique in electro-analytical chemistry, is the **Polarographic Method** invented about 16 years ago by Heyrovsky. It is based on the principle that when a continuously increasing potential difference is applied to a solution containing electro-reducible or oxidisable substances, the current passing through the solution shows stepwise increases at finite voltages corresponding to the "decomposition voltages" of the substances present. Under favourable conditions as with a cathode of dropping mercury, steady and reproducible, current-voltage curves can be obtained. The voltage at which any step occurs, or better still the "half-wave potential", *i.e.*, the potential of the dropping electrode against an external reference electrode, is characteristic of some definite electro-reducible substance present in solution. Also, the value of the limiting current of each step or wave, is determined by the concentration of the substance causing it. Thus it is often possible to obtain a simultaneous qualitative and quantitative analysis for several constituents in an unknown solution from a single current-voltage curve. The number of substances subject to polarographic determination is potentially very great, including all the common electro-reducible inorganic ions and a large variety of organic substances. The method is specially suitable for small concentrations (10^{-5} to 10^{-2} molar) and can be carried out with a volume of solution as small as 0·1 c.c. or even less. The principles and theories involved in this highly promising and widely applicable analytical method have been recently reviewed by I. M. Kolthoff and J. J. Lingane in the February number of the *Chemical Reviews* (1939, 24, 1–91).

M. A. G. RAU.

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Artificial Ripening of Fruits with Acetylene.—According to a press note from the International Institute of Agriculture, Rome, the results obtained during the past ten years at different experiment stations, in the United States, the Union of South Africa, Australia, Italy and France, in the use of acetylene for artificial ripening of bananas, tomatoes, citrus fruit, pineapples, plums, etc., justify the use of this process in commercial practice. In this connection, the conclusion of the Marrakesh Experiment Station, Morocco, may be quoted "artificial colouring by means of acetylene gas is a commercial operation that makes it possible to market fruit about ten days in advance of the normal marketable date without in any way affecting its intrinsic varietal qualities". An article published in the *Monthly Bulletin of Agricultural Science & Practice* (1939, 30, 1), deals with the artificial ripening of fruits by acetylene. It is shown that "the action of acetylene is comparable with that of ethylene since its only effect is to hasten natural ripening by stimulating the action of the enzymes that normally exist in the plant".

* * *

In a recent number of the *Proceedings of the Royal Irish Academy* (Vol. XLV, Section B, No. 11), Dr. J. Kaye Charlesworth has published an interesting paper on "Some observations on the glaciation of north-east Ireland". The previous work of Dr. Dwerryhouse in 1923 on the glacial geology of this area had already established two important conclusions: (1) that of an early Scottish glaciation of north-east Ireland, the limits of which lay west of the present area; and (2) that of a subsequent union of Scottish and Irish ice-sheets which formed confocal hyperbolæ, more or less symmetrically disposed about Lough Neagh. The present study by Dr. Charlesworth deals with the way in which the ice disappeared from the Lough Neagh area and the valleys of the Bann, Main and Lagan, involving a detailed mapping of the fluvio-glacial sands and gravels which Dwerryhouse had largely neglected. As a result of this work, the author has shown many other things, that the drumlins of north-east Ireland "belong to the last main glaciation when the Scottish ice and Irish ice were confluent over the Loch Neagh basin. Their lack of parallelism with the successive ice-fronts established by other means and the dependence of their alignment upon major physical features seem to prove this age and relationship". The investigations described in this paper represent a further development of those of Dwerryhouse.

* * *

Observations on Crystalline Silica in Certain Devitrified Glasses.—Tool and Insley (*J. Research, National Bureau of Standards*, 1938, 21, 743) present the results of a series of tests

made with a view to observe in devitrifying glass the transformations: noncrystalline silica-crystobalite-trydimite-quartz, in the temperature range 625° to 950° C. A study of the devitrification products was made by obtaining the heating and cooling curves during the process and also by microscopic and X-ray observations.

Data are given for (*a*) inversion points of crystobalite on heating and on cooling; (*b*) the upper and lower inversion points of trydimite on heating and on cooling; and (*c*) inversion point of quartz.

The authors discuss the significance from several points of view the observed features of the inversion effects in the upper trydimite range.

K. R. K.

* * *

Concrete as X-Ray Protective Material.—With a view to avoid the high cost and the problem of supporting the large mass of lead required for X-ray protection at potentials above 200 kv., George Singer, Lauriston S. Taylor and Arvid L. Charlton (*J. Research, National Bureau of Standards*, 1938, 21, 783) have investigated the lead equivalents of various types of concrete in the range 200-400 kv. The protection coefficient of concrete was found to increase rapidly with increasing excitation potential, *e.g.*, a barrier of about 30 cm. was adequate at 400 kv. while at 200 kv. the thickness required was 22 cm.

K. R. K.

* * *

Physiological Palmistry.—Many believed and still believe that the dispositions and even the fates of persons can be read by a study of the individually different formations of the lines of the hand. The prosaic physiologist like Prof. Dr. Armin Tschermak-Seysenagg of the German University at Prague, sees in it (*Forsch. u. Fortsch.*, 1939, 15, 214) only a tube-like structure of our skins, which resembles the plate-like structure of the epidermal armour of certain animals. The skin folds itself according to and corresponding to these lines, during certain movements and positions. The most important hand lines are as follows: first the thumb bending line, secondly the opposition line (the life line of the Chiromancers)—corresponding to the placing of the thumb exactly opposite to the other four fingers held in the stretched out position, thirdly a pincer or principal folding line of the palm corresponding to the folding through complete pincer closure between the thumb and the four finger group, fourthly a pointer line corresponding to the small pincer closure between the thumb and three fingers towards the ulna, the pointer finger being kept stretched, fifthly an approachment line (the fate line of the Chiromancers) of the two pairs of the four finger group under stretching of the middle finger, sixthly a folding line of the fourth and little fingers—used when the fourth and fifth fingers are bent keeping the second and third fingers stretched, which is the usual position when administering an oath or a blessing. A double furrow permits the bending of the palm towards the lower arm, corresponding to the first and the second steps in the folding of the hand. This kind of formation of the skin exists already in the case of newly born children. Just the same way as the furrows on a finger can be recorded as in Dactylcscopy so also can these lines be recorded like a document by smearing the palm with soot, printer's ink, and oil colours and then pressing on a paper. In this way was proved a remarkable identity in the formations of the lines of the hand in the case of a pair of single cell twins. Much more interesting and instructive are the so-called Rontgenchirogrammes which are obtained by rubbing on to the palm Bismuth pulp, or Bismuth ointment, and then wiping it off and afterwards obtaining a Rontgen photograph. Thereby it appears that the relationship of the position of the lines of the hand to that of the bones and joints of the hand, can be determined. It is to be expected that out of this will arise a perfectioning of the system of registering and identification of individual persons, which is so important from the criminological point of view. N. G. C.

* * *

Hand-made Paper.—The Industrial Section of the Indian Museum (Botanical Survey of India) has collected valuable information from various parts of India on the methods of manufacturing hand-made paper. A sample of paper obtained from Nepal, which is said to last for 1,000 years or more, has been exhibited at the Indian Museum, Calcutta, where charts have been put up showing in a simple manner the processes through which hand-made paper has to pass before it emerges out as finished product.

The fibre of *Sunn Hemp* (*Crotalaria juncea*) is the principal raw material for making paper in Manipur State. In the Shan States, the bark of *Thale* (*Broussonetia papyrifera*) is employed. Rags, old clothes, cotton waste, etc., are generally employed for making good paper in various parts of India.

Other raw materials used for paper-making are, straw, bamboo, the bark of *Aquilaria agallocha* and jute. The Industrial Research Laboratory of the Industries Department, Government of Bengal, has been investigating the possibilities of using dried water-hyacinth stems and stems of jute plant stripped of the fibre, for making paper. The Benares Hindu University has taken up the production of hand-made paper from easily available raw materials. Experiments have also been undertaken at the Forest Research Institute, Dehra Dun, to improve indigenous methods with a view to developing hand paper-making into a cottage industry.

* * *

Vegetable Rennet.—An extract from the berry of *Withania coagulanas* obtained from the N.W. Frontier Provinces, can be employed as a substitute for rennet in cheese making. It is understood that cheddar cheese and soft cheese of good quality have been prepared at the Imperial Dairy Institute, Bangalore, by employing vegetable rennet.

* * *

Iron and Coal Deposits.—New deposits of coal, iron and gold have been discovered in India according to the *General Report* of the Geological Survey of India for 1938.

In one workable seam alone in the Langrin area in Assam a total reserve of 80,000,000 tons of coal is indicated and there are 610,000,000 tons of first class iron ores in Bastar State, Eastern States Agency.

The coal area in Assam lies in the south-western corner of the Khasi Hills between the Um Mawblei and the border of the Garo Hills, into which also the coal-bearing strata extend. It is divided structurally into two unequal parts by a strong cross fault.

By far the most important areas for development are those of the Langrin plateau east of the fault. Coal seams outcrop in almost every deep ravine that discharges into the Sylhet plains between Bagali Bazar and the limestone outcrops beyond Barsaura. Most of these seams lie in deep gorges on the plateau and contain pebbles of coal from seams exposed in the cliffs on each side.

The mapping of the iron-ore deposits of the Bailadila range, Bastar State, has been completed. Ore deposits, large and rich enough to be worked economically, occur in numerous places along the two high ridges which flank the range and on the watershed of the Malengar at the southern end of the range. The largest deposits are two on the watershed of the Malengar and one about two and a half miles north of Loa. In these three deposits there are at least 400 million tons of ore.

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Indian Short-wave Stations.—The data collected by the Research Department of the All-India Radio during the past 18 months have yielded valuable information on the relative advantages of the short- over medium-waves and the choice of the day (31 metre) and night (60 metre) wave bands under the Indian conditions.

In the tropics, atmospherics also called static, mar reception during the monsoon weather. Measurements indicate that their magnitude is about fifty times greater in India than either in Europe or America; it is about fifty times stronger on medium- than on short-waves.

The 31-metre band is interference-free during the day. The chief considerations in the choice of the 60-metre band are: (1) freedom from interference due to other stations (unlike the overcrowded 49-metre band with 197 stations!); (2) good reception primarily in India; and (3) minimising the 'skip distance' trouble.

With these bands, therefore, Indian listeners can expect reasonably good reception in all seasons. It may be mentioned that the All-India Radio received proofs of satisfactory reception of Indian stations even from Europe and America.

* * *

Mineral Springs in India.—Occurrence of two sulphurous springs in Riasi District, Kashmir, is reported by the Geological Survey of India. The one, which is situated about a quarter of a mile above Khar along the Tawi River, discharges hot water only during winter. It precipitates a good deal of milk of sulphur. The other is the well-known thermal spring at Tattapani. Its water is apparently possessed of certain therapeutic properties for curing skin diseases and gouty affections. The water gives a strong sulphurous odour and maintains a constant high temperature of 70°-80° C.

Several years ago the Geological Survey of India compiled a catalogue of the hot springs in this country, but this information is in need of additions both with regard to the radio-active and mineral character of the waters from a geological aspect and the medicinal properties of the water from a medical point of view.

It is understood that an exhaustive examination of the mineral springs of India is under consideration and it is hoped that the Geological Survey of India will shortly undertake the work. The determination of the physical and chemical constitution of the mineral waters must be supplemented by an investigation of the cures which are said to have been effected by the various waters and for this purpose medical collaboration appears essential.

* * *

Laminated Wood.—It is curious that while much attention has been paid in this country to the possibility of Plywood manufacture, laminated wood construction (more commonly called "Laminboards") is still in the nature of novelty. Laminboard technique has made great advances in Europe and America and large panels right up to 30 to 40 mm. thick are available at competitive prices. The many advantages which such construction offers are of even more value in a country like India with its extreme climatic conditions.

In a recent pamphlet by Mr. W. Nagle, Officer-in-charge, Wood Working Section, Forest Research Institute, Dehra Dun, the basic information about laminated wood is presented in seven compact and readable sections entitled Introduction, The History of Laminboards, Methods of Manufacture of Laminboards, Uses of Laminboards, Cost of Laminboard Making Plant, Details of a small Laminboard Plant and Some Machine Makers. The information provided in these paragraphs is just enough and of the kind to enable the serious student or manufacturer to ask further questions regarding details. Such enquiries, Captain H. Trotter, Utilisation Officer, Forest Research Institute, Dehra Dun, assures the reader in a "Foreword", will be gladly answered.

The publication is illustrated by a number of photographs. The frontispiece illustrating the Board Room at the Forest Research Institute, Dehra Dun, does scant justice to the beauty of the original. It is true that no "black and white" picture can adequately bring out the quiet charm of wood panels but the reviewer cannot help feeling that a little more expense for better "get-up" of the illustrations would be justifiable in such avowedly propagandist publications.

EMMENNAR.

* * *

India Meteorological Department.—The Administration Report (1937-38) of the Meteorological Department of the Government of India, that has been recently published, gives a brief account of the routine work of the Department as well as of the developments—some of them of far-reaching importance—that have been carried out during the year. The Report contains matter of considerable public interest, and will enable the reader to form an estimate

of the services rendered by the Department in the various activities concerning the affairs of the country. The first section of the report opens with a tribute to the memory of Mr. J. H. Field, a former Director-General of Observatories, who, it will be remembered, was responsible for a large amount of pioneer work in connection with the organisation required for the study of upper air in India. In the same section are summarised the outstanding features in the developments effected during the year. Mention is made of the preparation of the additional afternoon weather chart daily from 1st April 1937. Two forecasts are thus issued every day from Poona and a synoptic chart from the afternoon observations is also printed in the Daily Weather Report. Commencing from 1st August 1937, broadcasts of regional weather data have been made twice daily from the short-wave æronautical wireless stations at Karachi and Calcutta. A short-wave station is under construction at Poona by the Posts and Telegraphs Department which, when completed, will enable the Headquarters Office to issue collective and regional synoptic data. Several improvements have been brought into effect, in the meteorological service to aviation interests, since the introduction of the Empire Air Mail scheme and the development of internal air transport.

In Section II of the Report are given in some detail the services of the Department in connection with storm warnings to shipping in the Indian waters; and in Section III, we have an account of the arrangements made for supplying weather information and forecasts to aviators on the various air routes in the country. Section V contains a brief description of the normal duties of the different sections of the Headquarters Office as well as of the meteorological offices and observatories maintained by the Department. A concise account is given of the special researches carried on at these centres and is sure to be of interest not only to meteorologists but also to workers in allied branches of science. Of particular importance to an agricultural country like India are the investigations made in the Agricultural Meteorology Section at Poona where studies have been continued on a number of problems connected with climate and crops.

The study of the earthquakes that recently occurred in India and its neighbourhood, and the determination of focal depths in some cases, have received attention at the Colaba Observatory, which acts as a central station for collecting and editing the data obtained from the records of all the seismographs operating in India and Ceylon. A quarterly Bulletin containing the readings of the principal phases of seismograms is being published from the beginning of 1938.

Much of the routine work of the Kodaikanal Observatory is planned in co-operation with the International Astronomical Union. Among the chief features of the year, mention is made of the discussion of the observations secured at the Observatory Eclipse Expedition to Japan in 1936, the publication of a note on the presence of oxygen in solar prominences and the construction of a 13 ft. spectrograph of the Littrow type for the systematic study of the contours of selected lines in different parts of the sun's disc and in sunspots.

A list of publications issued during the year is contained in Appendix B, which gives an idea of the extent of the research activities of the Department. T. P. B.

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The Report for 1938 of the **Solar Physics Observatory**, Kodaikanal, which specialises in the study of the Sun and makes daily visual and photographic observations of its changing features has just been issued.

There was a slight decrease in almost all forms of solar activity during the year except in prominence areas which showed an increase over the previous year's. Not on one day was the Sun's disc free from spots. The mean daily number of sunspots fell by 16 per cent. and the number of new groups by 13 per cent. An increase of 12 per cent. was observed in the mean daily areas of calcium prominences, but the mean daily numbers of prominences decreased by 6 per cent.

Photographs of the Sun on a scale of eight inches to the Sun's diameter were taken on 328 days using a six-inch achromatic object glass and a green colour filter. A statistical study of prominence areas was made to determine the possible influence of the earth on solar prominences. Photometric work on the intensities and contours of selected Fraunhofer lines made further progress.

A line-shifter was designed and mounted on the $H\alpha$ spectroheliograph and a twelve-inch siderostat was built up and mounted. The spectrum of Bromine was photographed and precise measures of intensity were made by photographic photometry for a few lines.

Data of cosmic radiation obtained from measurements at Agra and Kodaikanal were analysed and its diurnal variation with mean and sidereal times worked out.

Weather conditions were slightly less favourable for solar observation. The Observatory carried out the programme of the International Astronomical Union.

The Milne-Shaw Seismograph recorded 255 earthquakes during the year.

* * *

Report on Child Welfare.—The League of Nations has just published the *Annual Report* on Child Welfare prepared by the Child Welfare Information Centre, containing a survey of the principal legislative and administrative measures adopted or examined in 1937 in some thirty countries, with a view to improving and extending the protection afforded to the child, its mother and the family (*Document Ser. L.o.N.P.*, 1939, 4, 5, pp. 201. Price 4*sh.*).

A Press Communique issued by the Information Section of the League, draws attention to the important features of the report, which gives *inter alia* a general account of the measures adopted in China and a summary account of the work being done in the province of Kwang-si, the most advanced province as regards the organisation of social services. Some short historical notes are included in the report, which show the importance of the social evolution at present transforming China.

The information on the United States and the United Kingdom is very complete, and shows the importance attached by these great countries to the improvement of the health of the mother and child and to physical education.

The report contains a concise summary of measures concerning the child contained in the Swiss Penal Code of December 31st, 1937, as well as interesting information on Turkish child welfare legislation and its application.

The report should prove useful to all who are interested in the organisation and social development of the various countries or who are investigating the methods adopted to protect the mother and child with a view to determining a country's level of civilisation.

* * *

Atmospheric Pollution.—The purity of the atmosphere is a matter of concern to everyone, especially those living in industrial districts and crowded city areas. The available facts on the extent, character and variation of atmospheric pollution are contained in the Annual Reports on observations made by local authorities and other bodies co-operating with the Department of Scientific and Industrial Research in the study of the subject. The 24th Report, just issued (H.M. Stationery Office; Price 2*sh.* net.; General Deposit Tables 4*sh.* 6*d.* net.), records and discusses the results obtained in the year ending 31st March 1938. A special illustrated section of the Report is devoted to a brief explanation, in simple language, of the part played by atmospheric pollution and other factors, in causing fogs.

The results of measurements made with the deposit gauge are, as usual, analysed and discussed in the Report, but the detailed figures of deposited impurity, contained in the General Deposit Tables, which were formerly embodied in the Report, are now issued as a separate publication.

* * *

The Seventieth Annual Report of the **American Museum of Natural History**, recently received, records a general expansion in the activities of the museum; this is remarkable considering the fact that the management was faced with a fall in the income and many departments were understaffed. New exhibits were added and the scientific and educational work of the Museum were extended. At the request of the authorities of the New York World Fair, the Museum has planned a temporary exhibition of primitive art, utilising original pieces from the extensive collection from the Americas, Africa and Polynesia. In the Hayden Planetarium, two spectacles designed for the layman's appreciation of atsronomy are planned. One reveals the circumstances by means of which, life on earth or the earth itself might come to an end; the other carries the visitor on a trip to the moon and gives him a realistic picture of the surface of our nearest cosmic neighbour.

The research activities of the Museum cover a very wide field, and the results of the investigations have been recorded in several reports, monographs and journals; mention may be made of the work on the social behaviour of the vertebrates, evolution of the brain in fossil and recent vertebrates, dentition and jaws of the fossil South African man-apes. The Asiatic Exploration and research was continued and the results obtained by Dr. Glover M. Allen, on the mammals of China and Mongolia were published as Part 1 of Volume 9 of the series in the *Natural History of Central Asia.* Several expeditions were undertaken in North America, Central America, South America, Asia, Africa, South Seas and Pacific Islands, for acquiring specimens and for study. A study of the report cannot fail to impress the reader with the enormous influence which the Museum exercises in popularising scientific knowledge.

* * *

Spectrochimica Acta.—We have received the first number of the new journal, published by the well-known firm of Julius Springer, with the co-operation of an International Board of Chemists. Chemical analysis, both qualitative and quantitative, by the methods of emission spectra are being increasingly adopted by many firms and institutions. Improved technics in exciting the spectral lines, and their estimations both by visual and photographic methods, have brought out the general advantages of rapidity and convenience in these methods. In special cases as in 'trace' analysis, or in the estimation of rare-earth impurities, spectro-chemical methods possess distinct advantages. Their applicability to wider regions as in the identification of different alloys, precipitates, concentrates, frits, enamels, etc., has called forth special researches, and a forum for the publication of these researches is now provided by the new journal. The Board of Editors are R. Brackpot (Louvain), A. Gatterer (Castel Gandolfo), W. Gerlach (München), G. Scheibe (München) and F. Twyman (London). The journal will be published at varying intervals. The first number (24 May 1939; Price 8·60 RM.) starts off with a contribution from Prof. H. Kayser on "Beobachtungen über Abfunkvorgänge bei der Spektral analyse von Aluminiumlegierungen". There are four other articles on "The Quantitative Spectrographic Analysis of Solder, Spelter Magnesium and Aluminium Alloys" (McClelland and Whalley), "Die quantitative Bestimmung kleinster Mengen von Europium in Samarium" (Gatterer and Junkes), "Über eine neue Anwendung der Emissionsspektroscopie zur lokalen Mikro-Analyse" (Scheibe and Martin), and "Die physikalischen Erscheinungen der Bogenentladung in ihrer Bedeutung für die spektralanalytischen Untersuchungs methoden" (Rollwagen). Finally there is a section, which will be a feature in all the numbers, on book reviews and abstracts of articles pertaining to the subject proper of the journal.

* * *

Humidification of Freezers.—The primary cause of deterioration in frozen products under the conditions prevailing in the freezers, now in vogue, is surface drying or as it is more generally known, freezer burn. This condition can be reduced or prevented by packing the product in a more or less moisture-proof manner. The refrigeration engineer has contributed very little to minimise this form of

deterioration beyond the possible use of very low storage temperatures.

Freezer burns can also be prevented by humidifying the atmosphere of the freezer. The practicability of the method was suggested by Dr. W. H. Cook of the National Research Council, Ottawa, in a paper presented at the Food Technology Conference recently held at the Massachusetts Institute of Technology. The conditions necessary for ensuring continuous evaporation from the product have been worked out and a humidifying apparatus has been designed which will serve to maintain humidities of 95% with a heat input equivalent to a 10–15% increase in the refrigerating load.

* * *

A delegation of agricultural experts with Mr. A. Mustafa, Agricultural Officer, Baluchistan, as leader and Dr. B. B. Mundkur, Assistant Mycologist, and Dr. Taskir Ahmad, Assistant Entomologist, of the **Imperial Institute of Agricultural Research**, New Delhi, as members, has left for Afghanistan, at the invitation of the Afghan Government with a view (1) to give suitable assistance and advice as is possible, to the Afghan Government in regard to crop production; and (2) to collect such information regarding Afghan agriculture as may be of interest and value to India. The delegation will devote particular attention to the fruit cultivation with special reference to the prevalent pests. A sprayer and necessary materials for spraying have been taken in order to demonstrate the methods of dealing with insect pests. Necessary equipment for collecting insect fungus and plant specimens has also been provided. Fruit cultivation, the most important item in Afghanistan Agriculture, is extensively carried out in the irrigated valleys lying to the south of the country. The delegation will also interest itself in problems connected with locusts and locust attacks. The locust affected area lies in the north-east and north of Afghanistan, especially in the plain of Oxcus. It is expected that the delegation will complete its labours in about a month.

* * *

Prof. F. C. Minett, D.Sc., M.R.C.V.S., Director of Research, Institute of Pathology, Royal Veterinary College, London, has been appointed Director, Imperial Veterinary Research Institute, Government of India. He is expected to take charge of his duties early in September.

* * *

University of Mysore.—1. The triennial elections to the Senate by and from the Academic Council and the Registered Graduates were held.

2. Refresher Courses for the High School teachers deputed by the Department of Public Instruction were held in the Maharaja's College, Mysore, in Arts subjects and the Central College, Bangalore, in Science subjects.

3. Arrangements were made for publishing the following Extension Hand-books in Kannada: (1) Our Villages. (2) Astronomy. (3) Diseases of Society. (4) Taxes. (5) Nine Gems.

4. The results of the University Examinations held in March 1939 were announced. They were as under;—

Sl. No.	Examination	Examined	Passed
1	Intermediate	1,294	554
2	B.A. (New)	158	85
3	B.A. (Old)	3	2
4	B.Sc.	193	116
5	B. A.(Hons.) Preliminary ..	41	31
6	B.Sc. (Hons.) Preliminary ..	32	27
7	B.A. (Hons.) Final	44	40
8	B.Sc. (Hons.) Final ..	47	45
9	M.A. (Qualifying Test) ..	4	4
10	M.Sc. (Qualifying Test) ..	1	1
11	B.T.	54	37
12	First Examination in Engineering	73	58
13	Second Examination in Engineering	73	41
14	B.E.	47	34
15	Pre-Medical	29	10
16	First M.B.B.S.	25	13
17	Second M.B.B.S.	29	19
18	Final M.B.B.S.—Part I ..	21	14
	Part II ..	28	14
	October 1938		
19	First L.M.P.	17	9
20	Second L.M.P.	25	17
21	Third L.M.P.	45	22
22	Final L.M.P.	46	26
	March 1939		
23	First L.M.P.	49	32
24	Second L.M.P.	34	17
25	Third L.M.P.	46	23
26	Final L.M.P.	44	23

* * *

Royal Institute of Science.—The recent University results have been satisfactory. Out of the 80 candidates who appeared for the B.Sc. Principal subjects, 72 have passed giving a total percentage of 90.

Dr. R. C. Shah has been promoted to B.E.S. Class I, as Professor of Organic Chemistry.

Dr. Y. G. Naik, PH.D. (Bom.), of the Physics Department, has been promoted to the post of Lecturer in Physics at the Gujerat College, Armedabad.

Dr. (Miss) M. M. Paranjpe, PH.D. (Lond.), has been appointed as Assistant Lecturer in the Physics Department in place of Dr. Y. G. Naik.

Mr. D. R. Nadkarni, M.SC., has joined the Chemistry Department as Assistant Lecturer.

The teaching of Mathematics will now be carried out jointly with the Mathematics staff of the Elphinstone College.

* * *

Announcements

A New **International Address Book** of Plant Taxonomists, Geographers and Ecologists is being prepared by the Editor of *Chronica Botanica* and will be issued in the near future in the "New Series of Plant Science Books". The Address Book will not only give the names and addresses of the scientists included, but also

their scientific interests, together with a conspectus of current and planned research. This is the same kind of information as was being included in *Chronica Botanica*, when it was issued as a year-book (Vols. I–III, 1935–37). Information on new research projects, especially in taxonomy, geography and ecology, in *Chronica Botanica*, the International Plant Science News Magazine, will henceforward be restricted to major co-operative projects and the like. As it is no longer practicable, or impossible, to compile an address book for the whole of plant science, it is hoped that similar address books will be prepared for other branches of plant sciences, *e.g.*, general botany (morphology, physiology, genetics), plant pathology, agronomy, horticulture and forestry.

Dr. Verdoorn, Editor, *Chronica Botanica*, (P.O. Box 8, Leiden, Holland) will be glad to send relevant questionnaire cards to those interested, on request.

A New International Hormone Standard.—It is announced that the standard for the gonadotrophic hormone derived from the human urine of pregnancy, which was adopted last year by the League of Nations at its conference for the standardisation of hormones, is now ready for distribution.

It consists of a mixture of six samples of hormone, which have been given by various manufacturers, and is presented in the form of tablets containing each about 100 international units of activity.

The National Institute for Medical Research at Hampstead has already sent supplies of this new standard to the national centres which have been set up in numerous countries for distribution to the scientific and commercial laboratories.

* * *

We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, Nos. 8 and 9 and Index to Vol. 57.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 3.

"Agricultural Gazette of New South Wales," Vol. 50, No. 6.

"Journal of the Royal Society of Arts," Vol. 87, Pts. 4509–17.

"The Philippine Agriculturist," Vol. 28, No. 1.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 5.

"L'Agricoltura Coloniale," Vol. 33, No. 5.

"Biochemical Journal," Vol. 33, No. 5.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 72, No. 6.

"Journal of the Institute of Brewing," Vol. 45, No. 6.

"The Journal of Chemical Physics," Vol. 7, No. 6.

"Journal of the Indian Chemical Society," Vol. 16, Nos. 4 and 5.

"Chemical Age," Vol. 40, Nos. 1039–42.

"Journal de Chimie Physique," Vol. 36, No. 3.

"Chemical Products," Vol. 2, No. 2.

"Experiment Station Record," Vol. 80, No. 5.

"Indian Forester," Vol. 55, No. 7.

"Indian Forest Records," Vol. 3, No. 6.

"Forschungen und Fortschritte," Vol. 15, Nos. 16–18.

"Transactions of the Faraday Society," Vol. 35, No. 218.

"Review of Applied Mycology," Vol. 18, Nos. 4 and 5.

"The Bulletin of the American Meteorological Society," Vol. 20, No. 4.

"Nature," Vol. 143, Nos. 3625–33.

"American Museum of Natural History," Vol. 43, No. 5 and Vol. 44, No. 1.

"Journal of Nutrition," Vol. 17, Nos. 5 and 17.

"Journal of the Bombay Natural History," Vol. 40, Nos. 3 and 4.

"Indian Journal of Physics," Vol. 13, Pts. 1 and 2.

"Canadian Journal of Research," Vol. 17, Nos. 3 and 4.

"Research and Progress," Vol. 5, No. 4.

"Sky," Vol. 3, Nos. 5, 7 and 8.

"Science Forum," Vol. 4, No. 1.

"Science Reports of the Tohoku Imperial University, Japan," Vol. 13, Nos. 1–4.

"Indian Trade Journal," Vol. 132, Nos. 1715–16; and Vol. 133, Nos. 1717–24.

"Indian Central Jute Committee Bulletin," Vol. 2, No. 3.

"Comptes Rendus (Docklady)," Vol. 22, Nos. 5 and 6.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 1.

"Calcutta Medical Journal," Vol. 35, No. 6.

"Indian Medical Gazette," Vol. 74, No. 5.

"Occasional Notes (Royal Astronomical Society)," No. 4.

"Proceedings of Royal Netherlands Academy, Amsterdam," Vol. 42, No. 2.

"The Lingnan Science Journal," Vol. 18, No. 2.

"Science Progress," Vol. 33, No. 132.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 9, No. 1.

"Proceedings of the Royal Society of Edinburgh," Vol. 58, Pt. 3, and Vol. 59, Pt. 1.

"Proceedings of the Royal Irish Academy, Dublin," Vol. 45, Pts. 7–12 (Section B).

Catalogues:

"Books on Insects and Spiders"; "Monthly List of Books on Natural History and Science—May 1939" (Wheldon & Wesley, Ltd., London).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences

June 1939. SECTION A.—SIR C. V. RAMAN AND K. SUBBA RAMAIAH: *On the Wave-like Character of Periodic Precipitates.* Fourteen micro-photographs and enlargements of Liesegang precipitates are reproduced to show the characteristic superposition effects observable with waves. The examples illustrate the varying effects of the superposition of two wave-trains when their wave-length, direction, and amplitude are individually and collectively different. The so-called primary and secondary rings obtained with silver-chromate precipitates in gelatin are related to each other as a group is to the individual waves of which it is composed. K. SUBBA RAMAIAH: *Studies on Liesegang Rings.* It is shown that the fine secondary rings consist of silver chromate and are not due to the presence of impurities in the gelatin. Under suitable conditions, the precipitation of silver chloride and silver phosphate in gelatin is a periodic process, giving rise to a series of extremely fine rings. The rings exhibit interesting optical effects, such as diffraction spectra and different coloured haloes. S. MINAKSHI SUNDARAM: *On Non-Linear Partial Differential Equations of the Parabolic Type.* S. MINAKSHI SUNDARAM: *On Non-Linear Partial Differential Equations of the Hyperbolic Type.* M. W. CHIPLONKAR: *A Simple Cylindrical Lens Spectrograph for the Optical Determination of the Concentration of Ozone in the Atmospheric Layers near the Ground.* The slit and collimator are dispensed with, and the spherical camera lens is replaced by a cylindrical lens with its axis parallel to the refracting edge of the prism. R. K. MEHRA AND K. C. PANDYA: *The Condensation of Aldehydes—Part X. Of* p-*Tolylaldehydes with Amides; Part XI. Of* p-*Tolylaldehyde with Malonic Acid and Malonanilic Acid.* The amides give bisamide products, and malonanilic acid the cinnamaldehyde. K. C. PANDYA, T. S. SODHI AND D. S. MITTAL: *Condensation of Aldehydes with Malonic Acid—Part XII. The Influence of Groups and of Other Factors.* The hydroxy group generally diminishes the yield, which rises when the group is methylated. The nitro-group has no influence. R. NARAYANASWAMI: *Some Measurements of Chloride, Nitrate and Nitrite Present in the Water of the Monsoon Rains at Bombay.* S. RANGASWAMI AND T. R. SESHADRI: *The Question of the Fixation of the Aromatic Double Bonds in Hydroxy-Chromones and Coumarins. Formation of Azo-Dyes.* T. VENKATARAYUDU: *The 7–15 Problem.*

June 1939. SECTION B.—B. N. SINGH AND S. N. SINGH: *Photoperiodism and the Phasic Development of* Crotalaria juncea. B. N. SINGH, S. N. SINGH AND K. M. NAIR: *The Influence of Moisture Content and Nitrate Feeding on the Nitrogen Cycle in the Soil both under Aerobic and Anaerobic Conditions.* N. KESAVA PANIKKAR AND R. GOPALA AIYAR: *Observations on Breeding in Brackish-Water Animals of Madras.* SHYAM SUNDER LAL: *The Internal Ear of* Scoliodon sorrakowah (*Cuvier*).

Indian Chemical Society

April 1939.—R. N. MITTRA: *Formation of periodic precipitate in the absence of a foreign gel—Part II. Ferric hydroxide sol by different methods.* R. N. MITTRA: *Cupric hydroxide sol.* PRAFULLA KUMAR BOSE AND JOGENDRALAL BOSE: *Natural Flavones—Part III. On the constitution of tambulin.* K. P. BASU AND M. K. HALDAR: *Supplementary relations between the proteins of pulses and those of milk by the balance-sheet and growth methods.* P. C. MITTER AND LAKSHMI KANTA DE: *Studies in the γ-ketonic acids—Part II.* K. P. BASU AND M. K. HALDAR: *Biological value of the proteins of* Cicer arietinum (*Bengal gram*) *and* Cajanus indicus (*Arhar*) *by the balance-sheet and growth methods.* SISIR KUMAR GUHA: *On the preparation of 7-methyl-3-hydroxythionaphthene and its condensation with isatin.*

May 1939.—S. M. MEHTA AND M. B. KABADI: *The electrical conductivity of solutions containing zinc hydroxide and sodium hydroxide.* M. C. NATH AND P. L. MUKHERJEE: *Crystallographic investigation of artostenone, the stenone isolated from the Indian summer fruit,* Artocarpus integrifolia *by means of Goniometer and X-rays.* W. V. BHAGWAT: *Dissociation constants of some organic acids from solubility measurements.* PANCHANAN NEOGI AND KANAI LAL MONDAL: *Resonance reaction—Part II.* BAIDYANATH GHOSH: *Vitamin C and Toxins—Part III. The effect of diphtheria toxin on Vitamin C metabolism.* R. K. BAHL AND SURJIT SINGH: *Action of fuming nitric acid on iodine.* S. S. BHATNAGAR, A. N. KAPUR AND MAHENDRA SARUP BHATNAGAR: *Adsorptive properties of synthetic resins—Part II. Adsorption of potassium salts of various anions.* S. R. PALIT AND G. N. BHATTACHARYA: *A note on the basicity and molecular weight of shellac.*

Meteorological Office Colloquium, Poona

June 9, 1939.—V. SATAKOPAN: *Orthogonal polynomials* vs. *Harmonic functions in Meteorology and Geophysics.*

Errata

Vol. 8, No. 6, June 1939:

1. Note entitled "A Magnetic Study of the Oxides of Chromium and Manganese": *insert* the following between lines 22 and 23 in column 2 on page 253:— "at 65° after which there is a continuous fall".
2. The article entitled "Agricultural Marketing in Northern India": Page 277, column 1, *substitute* the word "linseed" in line 45 by "licensed" and *omit* the words "the failure of" appearing in lines 11 and 12 in column 2 of the same page.

10-8-39—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.Sc., for the Board of Editors, "Current Science", Bangalore

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Shell-Fisheries in the Andamans

IN reviewing the activities of the Zoological Survey of India during the years 1932–35, and 1935–38, we have had occasion in our editorials of December 1935 and of April 1939, to refer briefly to the part played by this Department in the scientific investigation of problems of economic importance such as, for instance, amongst others, the shell-fisheries in the Andamans. The recent publication by this Department of a *Consolidated Report on the Shell-Fisheries in the Andaman and Nicobar Islands during the years, 1930–35* enables us to assess the value of the fishery research work which the Department had been called upon to undertake early in 1930, under conditions not comparable to those of enlightened Governments more prosperous and resourceful than the Government of India. Many departmental reports suffer the fate of being filed and forgotten in Government Secretariats, but we are happy to note that the Director, Zoological Survey of India, has consolidated the reports of his scientific staff and published the results of six years' hard work in an intelligible form, so that they may be available to the general public interested in the scientific and economic progress of this country.

The Report is divided into three parts, the first of which deals with (1) the genesis and history of the shell-fishery in the Andaman Islands; (2) the fishing methods of the Japanese who discovered the valuable beds of Top and Turban shells (*Trochus niloticus* and *Turbo marmoratus*) around the islands of the Andaman and Nicobar groups; and (3) the scientific work of the officers of the Zoological Survey on these shell-fishes and their recommendations to preserve and perpetuate the shell-fishery. The second part consists of Tables of measurements of the

shell-fish and their eggs, of records of field-studies and of various other data on which the entire Report is based. The third part embodies the reports of individual officers deputed for fishery work which serve as a reference to the study of the first part. A grasp of the topography of the Andaman and Nicobar Islands and the adjacent islands of the Bay of Bengal and the Malay archipelago is greatly facilitated by the inclusion in the Report of two maps of these islands.

A sudden accession of wealth is no less embarrassing to Governments than to individuals. The knowledge that extensive and valuable mother-of-pearl shell-beds were discovered for them unintentionally by a band of intrepid Japanese in the territorial waters of the unguarded and uninhabited coasts of the two hundred and odd islands under their administrative charge seems to have put the Local Government at Port Blair in an unenviable position of embarrassment. The Andamans Government, however, lost no time in issuing licences to the Japanese of Singapore to collect mother-of-pearl shells on these coasts and in collecting royalty on the quantities of shells fished. They also realised at the same time that it was necessary to assess the extent of this new marine wealth and the possibilities of its further exploitation, and to take adequate steps to safeguard the fishery as a permanent source of income. The Local Government's timely decision to call in the aid of the Zoological Survey to solve the problems of exploitation and preservation of the fishery was praiseworthy for its wisdom and far-sightedness.

The preliminary investigation by the Zoological Survey early in 1930 not long after a fleet of Japanese fishing vessels had been apprehended in Port Blair was concerned not only with the *Trochus* and *Turbo* shell-fishery but also with the exploitation of other sources of marine products including edible fish and Trepang or *Beche-de-mer*. This investigation showed that with proper management of the shell and other fisheries a net annual income of not less than Rs. 40,000 may be anticipated, an income that could meet the cost of a permanent staff of Zoologists at Port Blair to advise the Local Government on their fishery problems. The Government of India on the recommendations of the Director, Zoological Survey, based on the results of this investigation sanctioned a scheme of research for five years in the first instance, and appointed at Port Blair a marine Zoologist trained and recruited in England as the Research Officer to study the shell-fish and the fishery in detail and provide a scientific basis for the control of the fishery. Although the avalanche of the Government of India retrenchment schemes of 1931 descended on this officer when he had been in office for barely six months, the scheme of research was saved by the Zoological Survey stepping into the breach. At the end of the five-year period, however, the research work on the fishery which was by no means complete was abruptly terminated on grounds of financial stringency, when further facilities for essential research and for the safeguarding of the already depleted fishery were urgently needed.

Before dealing with the scientific aspects of the Report before us we wish to draw attention to the fact that the investigating officers of the Zoological Survey had from the commencement of the investigation early in 1930 realised that the shell-beds were bound to suffer serious depletion in the absence of an efficient inspecting staff to

control the licensed fishermen and to keep out poaching boats from fishing in territorial waters. That they had raised a warning finger is evident in their individual reports. The Director, Zoological Survey, in his preface to the present Report lays emphasis on this subject and, what was more serious from the point of view of the investigating officers, on the absence of a properly equipped laboratory fitted up with aquaria and running sea-water, and other requisites of sound biological work which, as he remarks, "made it impossible for the officer-in-charge to carry out detailed investigations on the bionomics, life-history, etc., of *Trochus niloticus*". It is difficult to understand why the Government of India agreed to initiate a scheme of research without a careful and adequate consideration of the immediate and future needs of their investigating officers. It is a pleasant surprise to us, however, that in spite of the handicaps of smallness of staff and meagreness of equipment the Zoological Survey was able to carry on its investigations in the Andamans for over five years and produce results which are of a no mean order.

The author of the consolidated Report who carried on investigations in the Andamans from 1932 onwards seems to have accumulated a great wealth of statistical and observational data which, we are glad to find, have been incorporated in the present Report. For, they not only help to understand the conclusions of the author but justify the control measures which the author has recommended for the regulation of the fishery. The facilities for the collection of these data which the Local Government were able to provide the author must have been utterly inadequate when compared to those which the Japanese licensees were in a position to give, and the author wisely availed of all the opportunities which the latter provided him of accompanying their fishing boats to the shell-beds around most of the islands of the Andaman and Nicobar groups in spite of the inevitable inconveniences of a small fishing craft. The data collected on these cruises with the Japanese were chiefly concerned with the rate of collection of shells by divers in various beds, the size, number and sex of shells collected in a day, the state of development of the eggs in various sizes of shells and the nature of the enemies affecting the life and commercial value of the shell-fish. The records of the size of eggs in *Trochus niloticus* of all available sizes from various localities show clearly that a fairly large percentage of shells 9 centimetres in maximum diameter is fully mature and bears a majority of full-sized eggs 0·20 to 0·25 millimetres in diameter, and justify the introduction of a 9·0 centimetre shell-gauge designed to prevent the fishing of young and immature shells. Unfortunately, *Trochus* shells 8·5 to 10·0 centimetres in maximum diameter seem to be of the highest market value because of the brilliant lustre of the mother-of-pearl layer on the inner surface of the shell and of the comparative freedom of the outer surface of the shell from animal or vegetable growths. The Japanese naturally regard these sizes of shells as constituting a first class commodity, and the graphs on pages 17 and 18 of the Report bear out the fact that the Japanese, during the years 1933–36, at any rate, preferred shells with maximum diameter of about 9–10 centimetres to those of other sizes, although in practice shells of less than 9 centimetres diameter with percentage frequency ranging from 5 to 20 had been fished in these years. The effect of the removal of young shells from the beds

farther away from Port Blair is not apparent because of the lack of facilities for collection of systematic data in those areas. But a picture of the systematic depletion of the large-sized shells in the shell-beds in the vicinity of Port Blair is provided by the graph on p. 16 of the Report which shows that in the four years 1931–32 to 1934–35 the percentage frequency of the small shells 3 centimetres in maximum diameter has gone up from as low a figure as 0·5 to about 45. The author was, however, able to show in 1934 (p. 20 of the Report) that the mean-size of shells in the Nicobar area collected in different months of a single fishing season showed a distinct tendency to fall as the months passed by as a result of intensive fishing in the same area, and we have no doubt that results similar to those gathered at Port Blair would have been obtained had it been possible to collect further data in the Nicobars.

The study of the rate of growth of *Trochus niloticus* was restricted to shells of certain bigger sizes only, as the experiments on the embryonic and the immediately higher stages of the shell-fish do not appear to have proved a success for lack of laboratory facilities of the right type. The experimental study of shells of 5 centimetres and above in maximum diameter has shown (1) that the rates of growth vary inversely with size of shell; (2) that growth in diameter is closely correlated with growth along the whorls of the shell; (3) that the female shell grows faster than the male shell; (4) that growth of shell is not influenced by seasonal variations; and (5) that the longevity of the species is approximately ten years. It is also clear from these studies that upto the end of the second year of their life the shell-fish have a size-range of 5·0 to 8·0 centimetres diameter when they are sexually unmature, and that the third year represented by the size-range 8·0 to 10·0 centimetres diameter is the most critical in their life as they then attain sexual maturity and begin to breed,—a stage at which the Japanese find it most profitable to market them. The reconciliation of the interests of the Japanese licensees and of those of the shell-fishery seems therefore, to have been a difficult matter when the Local Government had no means of enforcing the strict observance of their fishery regulations.

The ascertained facts in regard to the rate of growth at various ages or sizes of shells also show that if young shells in their second year of growth, that is, when they are 5·0 to 8·0 centimetres in maximum diameter, are allowed to grow for one fishing season more they will have reached maturity in their third year of life when they are 8·0 to 10·0 centimetres in maximum diameter, and have had at least one chance of leaving sufficient progeny to maintain the numerical strength of the beds depleted by fishing.

The introduction of a close season coinciding with the breeding period of the animal concerned is one of the well-known and recognised methods of regulating a fishery. The author of the Report has shown from a study (1) of the incidence of very young shells throughout the year; (2) of the percentage frequencies of various sizes of shells at any locality and in any part of the year; and (3) of the state of the reproductive products throughout the year, that *Trochus niloticus* breeds more or less continuously unlike many species of molluscs in temperate zones, which breed only in certain restricted seasons. The fixing of a close season for the Andamans cannot therefore be based on the breeding period of *Trochus*. The severity

of the monsoon from May to September when fishing is impossible along the Andaman and Nicobar coasts provides a natural though compulsory close-season.

From the economic point of view the shell-fishery in the Andamans proved to be a disappointment during the latter half of the period of the fishery. The steep decline in tonnage of shells in the second year of the fishery and the steady fall thereafter are clearly indicated in the graph on p. 24 of the Report. No one with knowledge of these shell-fisheries in other countries could have expected a better fate for the Andaman fishery which was at no stage under any sort of control by the authorities. Rules and regulations, if not rigorously enforced, do not carry conviction. The *Trochus* fishery in Mergui, Burma seems to have suffered a very similar fate. Making ample allowance for natural fluctuations in the breeding of *Trochus* and for variations in the period of fishing and in the number of divers employed for fishing shells, the decline of the fishery in the Andamans and in the Mergui archipelago is due, as the author of the Report points out, to the unrestricted and indiscriminate fishing of shells of all sizes by licensed as well as unlicensed Japanese fishermen, well organised and financially supported by the Japanese-owned fishery companies of Singapore. How efficient and thoroughly organised are the Japanese in the exploitation of the marine resources of the Indo-Pacific seas is vividly described by the author on pages 2 to 4 of the Report.

The fact that the Andamans and Nicobars and the Mergui archipelago are unguarded may have served as an invitation to the Japanese to explore the sheltered bays and winding creeks along these coasts, inaccessible to vessels larger than a small steam-launch or motor boat. It is not surprising therefore that many instances of poaching have been frequently reported to the respective Governments during the last few years of shell-fishing. We have seen occasional newspaper reports of arrests and trials of the Japanese masters of the fishing boats, and of confiscations and heavy fines as a deterrent punishment. The fact that the Japanese still dare to visit these coasts show that poaching is enormously profitable, and that the Governments concerned are helpless to prevent poaching. Contrast the measures taken by the Queensland and New Caledonian Governments to protect their shell-fisheries which have been stabilised during the past quarter of a century with the introduction and enforcement of stringent regulations.

The concluding part of the Report shows that the *Trochus* shell fishery has suffered such severe depletion that its rehabilitation would be almost an impossibility unless the Government of India is prepared to prohibit fishing of shells throughout the Andaman and Nicobar area for a period of at least three years, and at the same time keep their coasts clear of poachers by constant and vigilant patrolling. It is too much to hope that the Indian Government will agree to spend large sums of money on the policing of these islands to save an industry, the highest anticipated revenue from which is not expected to meet the cost of maintaining a preventive and scientific staff. All the same we cannot help expressing our regret that an important new marine industry has been allowed to go to ruin, because of the inability of the Government of India to keep away foreign exploiters from these islands. Far from wishing for a worse turn in the present international situation the *Trochus*

beds have still a chance of complete revival in the event of a European War which will give them a prolonged rest. We may recall the fact that many depleted fisheries of the North Sea and the Atlantic revived completely after the last Great War, and we have every hope that an enforced rest to the shell-beds in the Andamans such as a world war alone can give will restore them to their former plenitude.

We are of the opinion that the economic exploitation of our land and marine resources for the benefit of our people is a paramount duty of the Government of the country and no cost, however high, must be reckoned as an impediment to such exploitation. The National Planning Committee which recently met at Bombay seems to have decided that its immediate objective should be the establishment of new industries under the guidance and direction and with the material aid of the State, and the expansion of existing industries. It is also understood that the committee has appointed a separate sub-committee on fisheries. We earnestly hope that this sub-committee will fully consider the question of reviving the shell-fish industry of the Andamans.

The Liaison-Officer for India on the Staff of the Royal Botanic Gardens, Kew

THE appointment of Dr. K. N. Kaul of the Lucknow University, to serve as liaison-officer for India on the Staff of the Herbarium of the Royal Botainc Gardens, Kew, for a period of 2½ years, has recently been announced in the press. This appointment marks a new departure in filling this post, which is likely to promote very greatly the study of systematic botany in India, and enable India, in course of time, to have a number of systematic botanists trained at Kew and having first-hand knowledge of the Collections of Indian type material available at Kew and other European herbaria.

In order that Indian Scientists may realise the importance of the development, a brief history of the post may be given.

In 1883 there existed three main herbaria in India, those at Calcutta, Madras and Saharanpur, which could function properly only by maintaining close contact with Kew where all standard Indian collections were preserved. In order to meet the demands for information from these herbaria without undue delay, the India office agreed to appoint an assistant for India who was to devote himself to the interests of the Indian botanical institutions and *pari passu* to the maintenance and elaboration of the Indian botanical collections at Kew.

The assistant for India at Kew has actively collaborated in the preparation of the monumental flora of British India and the several provincial floras based upon it. The type material on which these standard works are based being preserved in the Kew Herbarium, no identification of Indian material can be really authoritative without comparison of these types at Kew. The services of the assistant are continually required in comparing and verifying such material, and in conducting enquiries of considerable economic importance both in agriculture and forestry.

The post has upto now been mostly held by botanists with wide experience of India, after their retirement. The experience gained by these officers has thus been completely lost to India. As a matter of fact no Indian

botanist had the opportunity of obtaining first-hand knowledge of the Indian collections preserved at Kew during the 55 years that the post has been maintained from Indian revenues.

Attention to this glaring anomaly was drawn by Prof. S. P. Agharkar during the session of the Third Imperial Botanic Conference held in London in 1935. Sir Arthur Hill, who presided over the Conference, dwelt on the question of the appointment of botanists as liaison-officers who could be appointed by Dominion Governments to work at Kew and drew attention to the admirable system adopted by the Union of South Africa whereby one of their younger systematic botanists was appointed to work at Kew for a period of two or three years, when he would be replaced by another member of the Union's botanical staff. He also mentioned that in this way a number of systematic botanists had acquired Kew training and experience and had been of inestimable value to the study of botany within the Union of South Africa. Discussion on the suggestion that a similar procedure should be adopted in the case of the assistant for India, was not permitted by the Chairman on the ground that the suggestion was not relevant to the proposal before the Conference.

On his return to India, Prof. Agharkar placed his views before the scientific organisations in India and as a consequence, representations were made to the Government of India to adopt the South African model for the appointment of the assistant for India by the *National Institute of Sciences of India*, the *Indian Botanical Society* and the *Indian Science Congress Association*. These proposals were, however, not agreed to by the Government of India, on the ground "that continuity of work in directions that call for long and undivided study may be maintained".

The question was taken up again in 1937 by Prof. B. Sahni and Prof. S. P. Agharkar as the result of which Sir Arthur Hill, Director of the Royal Botanic Gardens, Kew, expressed his approval of the proposal to the Government of India and suggested that the Government of India might give the proposal their careful consideration at the time of filling the post on the retirement of Mr. C. E. C. Fischer in July 1939. The question was also discussed at the symposium on "A National Herbarium for India", during the Silver Jubilee Session of the *Indian Science Congress* and the proposal approved.

It is gratifying to note that as a result of these efforts, the Government of India have agreed to the adoption of the South African model for the appointment of the assistant for India at Kew in future, and Dr. Kaul has been appointed to the post.

It is also satisfactory to note that the salary of the post, which was fixed as £ 100–10–160 p.a. many years ago, has now been increased to £ 250–5–260 p.a.

We hope that Dr. Kaul will fully utilise the opportunities offered to him during the next 2½ years so as to enable him to undertake a part of the work of identification of Indian plants in India itself.

S. P. A.

The Frequency of Polyembryony and Chlorophyll Deficiency in Rye

By Prof. Dontcho Kostoff

(*Academy of Sciences, U.S.S.R.*)

THE studies by Kappert[1] in *Linum* and those by Ramiah, Parthasarathi and Ramanujam[2] in *Oryza* showed that some plants, developing from twin seedlings are haploids. Namikawa and Kawakami[3] raised adult plants from wheat twins and found haploid, triploid and tetraploid plants among those with normal chromosome numbers. Studies in this field were carried out more recently on a large scale by a series of investigators. I shall recall here those by Harland,[4] Müntzing,[5] etc., which also showed that polyembryony leads to euploid chromosome alterations.

At the present time we have good methods for producing polyploid plants (colchicine, acenaphthene, bromnaphthalene, bromacenaphthene, etc.), but no reliable methods for producing haploids.[6] X-rays, abnormal temperatures and interspecific hybridizations seem to be less effective in this respect than polyembryony.

Haploids were reported in a large number of plants, when the latter are viable in highly inbred (homozygous) condition. *Secale cereale* is a cross fertilizer, which "degenerates" when inbred, therefore haploids from this plant would usually be lethal or semi-lethal. I attempted to verify this deduction. In doing this 27,020 grains of *Secale cereale* var. *viakta* were sown in boxes with sand. The surface was divided into 1 cm. × 1 cm. squares and then single grains were placed in each square half covered in sand. The seeds were watered regularly. Thus we raised 20,393 seedlings from 27,020 grains. Among these seedlings we found 5 twins, one triplet and 27 albinos. All ten plants from the twins and two of the triplet, that were studied cytologically had the normal somatic chromosome number, namely $2n = 14$. We also grew 39,606 seedlings in sowing 53,780 grains of *Secale cereale*—like derivatives from the interspecific cross *S. cereale* × *S. montanum*. Among these seedlings we found 32 twins and 7 albinos (Table I). Sixty plants of the twins had 14 somatic chromosomes, and one of them was a triploid (N 38) having 21 somatic chromosomes. Six plants of the twins died in an early stage of development, three of which were not studied cytologically. One of the diploid twins was a structural hybrid forming: (1) $5^{II} + 1^{III} + 1^{I}$, (2) $5^{II} + 1^{IV}$ and (3) $6^{II} + 2^{I}$; its twin plant being normal. Triploid plant formed a large percentage of abortive pollen, on the average 72 per cent. (July), 68 per cent. (September), 84 per cent. (October). Most of the pollen grains appeared usually in two when matured and studied in aceto-carmine preparations, one or both of the twin pollen being usually abortive. When only one of the twin pollen is abortive, the viable twin pollen was much larger than the abortive one (Figs. 1 and 2).

TABLE I

Plants	Seeds sown	Seedlings grown	Pairs of twins found		Triplets	Albinos	
			Number	Per cent.		Number	Per cent.
Secale cereale var. *viatka* ..	27,020	20,393	5	0·029	1	27	0·132
Secale cereale-like derivatives from *S. cereale* × *S. montanum* ..	53,780	39,606	32	0·08	..	7	0·0176
2411 *Triticum vulgare*	23,220	18,275	4	0·021	..	..	..

During the first meiosis we found 0 to 5 trivalents, most frequently, however, 2, 3 and 4 trivalents were formed. The plant formed eight spikes, six of them had altogether 216 spikelets, *i.e.*, 432 flowers. These six spikes set 8 grains from free pollination, two of the grains being small, shrunken with bad embryos. They did not germinate. Two spikes were bagged. No seeds were set under the bags.

The studies upon polyembryony in rye were followed up with similar studies in soft wheat—a plant that can be highly homozygotized without "degeneration" symptoms.

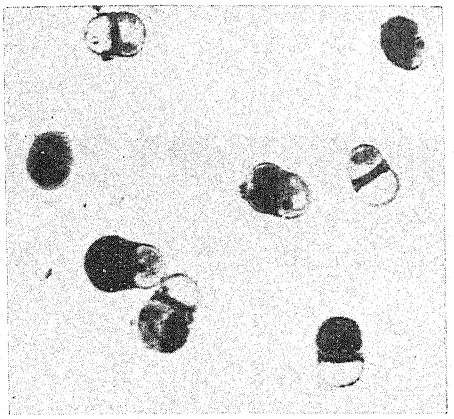

FIG. 1

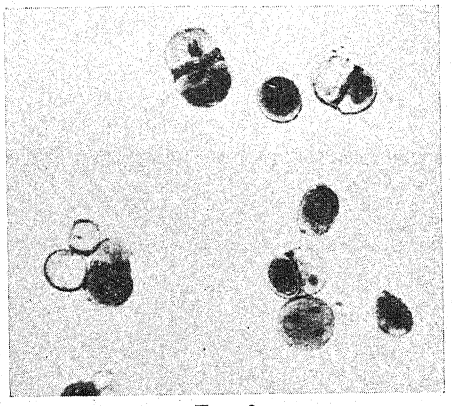

FIG. 2
Pollen from the triploid rye

We raised 18,275 seedlings from 23,220 grains of *Tr. vulgare* No. 2411. Among these seedlings we found four pairs of twins (Table I). Two seedlings of two different pairs were haploid ($n = 21$) while the other six seedlings developed into normal diploid (($2n = 42$) plants. Haploid plants were smaller, than the normal ones. Their spikes were smaller. During the first meiosis we usually found in aceto-carmine preparations from one of the haploids 21 univalents or one bivalent and 19 univalents. In a few cells two bivalents were found. In a single pollen-mother cell three bivalents were found.

Out of 73 plants raised from rye twin pairs and studied cytologically only one triploid and one structural hybrid was found but no haploids, while two haploids were raised out of eight wheat twin pairs, *i.e.*, 25 per cent. of haploids.

Until the present time adult haploids of *Secale cereale* have not yet been raised. Müntzing[7] obtained a semi-lethal haploid rye among the material treated by abnormal temperatures. Absence of haploids among the twin pairs that we studied is due most probably to the dying off of the haploids in an early stage of development; the diploid twin pairs being only able to survive and grow further.

There is a good deal of speculation about the mode of origin of more than one embryo in a single ovule. When polyembryony is a sequence of nucellar embryony, the embryos, the seedlings, and the plants that develop from them should be diploid with maternal genetic constitution. Twin embryos should also be diploid when they originate from two cells derived from the first cleavage products of the fertilized egg. When one embryo develops from the fertilized egg and the other from an endosperm all diploid + triploid twins may originate. When one embryo develops from the fertilized egg and the other from a haploid embryo sac cell (antipodal, for example) diploid + haploid twins will be formed. In the latter case it might happen that diploid + diploid twins develop if chromosome doubling takes place in the haploid embryo at an early developmental stage. Diploid + diploid twins or diploid + diploid + diploid triplets might also originate if two pollen-tubes penetrate the micropyle, the sperm of the one fertilizing the egg nucleus, while the other sperms fertilizing the polar nucleus and one or more than one antipodal nuclei. We do not know yet the mode of origin of tetraploid plants from twins and polyploids of a higher order. Fusion of antipodal cells and then polyspermic fertilization seem to be more probable processes, than chromosome doubling in one of the pairs of diploid + diploid twins at an early stage of development, but the latter alternative is not excluded.

The twins of *Secale* that we studied do not seem to result from nucellar embryony because they differed morphologically.

The normal procedure of the meiosis and normal fertility of the twin plant of the structural twin hybrid also supports this assumption. Structural hybrid formed about 50 per cent. of abortive pollen (Fig. 3) and was partially fertile.

Diploid + diploid *Secale* twins do not seem to result from diploid + haploid twins after a chromosome doubling in the haploid

one at an early developmental stage, because a diploid, derived from a haploid rye cell, the triploid resulting, most probably, from an endosperm cell. It seems very probable that usually single plants develop from *Secale* twin diploid + haploid embryos, the haploid usually dying at an early developmental stage.

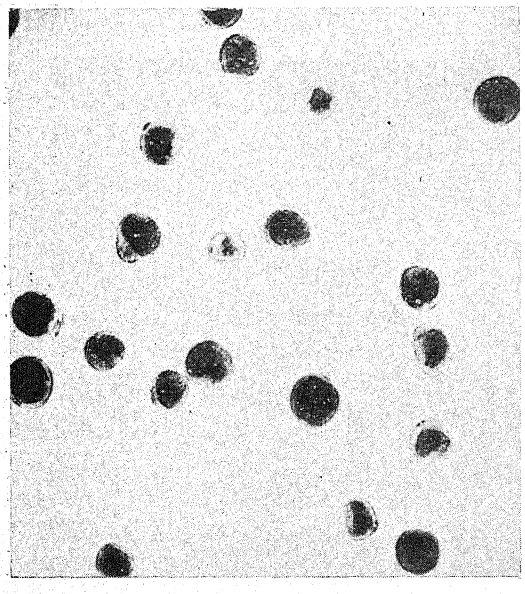

FIG. 3
Pollen from the structural hybrid raised from a twin pair

by somatic doubling will be nearly absolute homozygous form, the latter being usually semi-lethal or lethal. The most probable origin of the twin seedlings in rye that I studied seems to be: one from the fertilized egg and the other from a fertilized antipodal

Polyembryony in angiosperm plants is a very common phenomenon. They are chiefly due, as a rule, to certain deviations in the developmental and fertilization processes in the embryo-sac. They lead to euploid chromosome alterations, which have great evolutionary significance, especially the tetraploid and the haploid with partial autosyndesis during the meiosis.[6] The frequency of the polyembryony in our experiments is very high. In the rye *Viatka* it is about one per 3,500 and in *Secale cereale* derivatives—one per 1,200. In wheat it was about one per 5,000. The frequency of chlorophyll deficiency (albino seedlings) in *Viatka*—rye was about one per 800 and in *Secale cereale* derivatives it was about one per 6,000.

These numbers show an exceedingly high frequency of hereditary changes.

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1 Kappert, H., *Biol. Zentral.*, 1933, **53**, 276.

2 Ramiah *et al.*, *Curr. Sci.*, 1933, **1**, 277.

3 Namikawa and Kawakami, *Proc. Imper. Acad.*, Japan, 1934, **10**, 668.

4 Harland, S. G., *Jour. Heredity*, 1936, **27**, 229.

5 Müntzing, A., *Cytologia*, Fujii Jub. Vol., 1937, 211.

6 Kostoff, D., *Bibliographia Genetica*, **14** (in the press).

7 Müntzing, A., *Hereditas*, 1937, **23**, 401.

Thyroxine from Casein

LUDWIG and Mutzenbecher (*Z. Physiol. Chem.*, 1939, 258, 195) have prepared thyroxine from casein by treating it with iodine under carefully defined conditions in the presence of sodium bicarbonate and subsequent hydrolysis with barium hydroxide. The product, before hydrolysis contains 6·8 per cent. of organic iodine and has a thyroid activity of 200–500 guinea-pig units per gm. One gm. of this material yields on hydrolysis 50–100 mg. of crystalline thyroxine.

This work has now been confirmed by Harington *et. al.* (*Nature*, 1939, 144, 205) who also broadly discuss the mechanism of the synthesis.

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Temperature Dependence of Lindemann Frequency

Recently we have shown[1] that the surface-tension γ_f of a liquid at its melting-point T_f is given by

$$\nu_f = k\sqrt{\frac{\gamma_f}{m}},$$

where ν_f is the Lindemann frequency and m the mass of the molecule. Assuming that the expression holds at all temperatures, we have at any temperature T,

$$\nu = k\sqrt{\frac{\gamma}{m}}$$

whence from Eötvös rule we get

$$\nu = k\sqrt{\frac{\gamma V^{\frac{2}{3}}}{m V^{\frac{2}{3}}}} = k'\sqrt{\frac{T_c - T}{m V^{\frac{2}{3}}}}$$

and

$$\nu_f = k'\sqrt{\frac{T_c - T_f}{m V_f^{\frac{2}{3}}}}.$$

It follows that

$$\frac{\nu}{\nu_f} = \sqrt{\frac{T_c - T}{T_c - T_f}}\left(\frac{V_f}{V}\right)^{\frac{1}{3}} = \left(\frac{V_f}{V}\right)^{\frac{1}{3}}\sqrt{\theta},$$

which shows *directly* the decrease of ν with rise of temperature.[2] The surface-tension at any temperature becomes——and it follows also directly from Eötvös rule——

$$\gamma = \frac{1}{k^2} m \nu_f^2 \frac{T_c - T}{T_c - T_f}\left(\frac{V_f}{V}\right)^{\frac{2}{3}} = \gamma_f\left(\frac{V_f}{V}\right)^{\frac{2}{3}}\theta.$$

The viscosity at any temperature on Andrade's formula becomes

$$\eta = \eta_f\sqrt{\frac{T_c - T}{T_c - T_f}}\left(\frac{V_f}{V}\right)^{\frac{2}{3}} = \eta_f\left(\frac{V_f}{V}\right)^{\frac{2}{3}}\sqrt{\theta}.$$

It has been shown by one of us previously[3] that

$$V^{\frac{10}{3}}(T_c - T) = \text{constant},$$

whence $V = V_f\,\theta^{-\frac{3}{10}}$ .. .. (1)

and it follows that

$$\nu = \nu_f\theta^{\frac{3}{5}} \quad .. \quad .. \quad (2)$$

$$\gamma = \gamma_f\theta^{\frac{6}{5}} \quad .. \quad .. \quad (3)$$

$$\eta = \eta_f\theta^{\frac{7}{10}} \quad .. \quad .. \quad (4)$$

and compressibility

$$\beta = \beta_f\theta^{-1.3} \quad .. \quad .. \quad (5)$$

of which the relation (3) is similar to Van der Waals' equation and (4) is of limited applicability.

Thus it is seen that many of the physical properties of the liquids show a temperature dependence directly as function of a new reduced temperature θ defined by $\frac{T_c - T}{T_c - T_f}$.[4]

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Department of Physics, M. Rama Rao.
University of Mysore,
Bangalore,
August 1, 1939.

[1] Sibaiya and Rama Rao, *Nature*, 1939, **143**, 723.
[2] Macleod, *Proc. Phy. Soc.*, 1938, **53**, 788.
[3] Sibaiya, *Curr. Sci.*, 1938, **6**, 329.
[4] Bauer, Magat and Surdin, *Trans. Far. Soc.*, 1937, **33**, 81.

Some Interesting Phenomena at the Solid-Liquid Transition of Colloidal Stearic Acid

STEARIC ACID sols (prepared by the addition of an alcoholic solution of the substance into boiling water) are found to exhibit, on standing, the phenomenon of "Schlierung" in a striking manner. In the course of an investigation it was observed (K.S.R. and K.S.G.D.) that the Schlieren effect disappeared sharply on heating and reappeared in the cold, on standing. Ultra-microscopic examination revealed that the rod-like particles of colloidal stearic acid changed to spherical ones on heating and resumed their original shape in the cold (on standing). These observations afford a most convincing line of evidence to show that the Schlierung phenomenon is caused by the non-spherical shape of the particles. Further work with purified sols [(Late) M. P. V. Iyer and K.S.G.D.] revealed the following facts:—(*a*) the change occurs in the neighbourhood of the melting-point of stearic acid (66·8°C. ± 0·2°C.), (*b*) there is an inflection at the same temperature, in the conductivity-temperature curve of the sol and (*c*) there are sharp changes (as revealed by preliminary measurements) in the intensity and depolarisation of the light scattered by the particles at the same temperature. Details of these investigations as well as the subsequent work done on the subject will shortly be published elsewhere.

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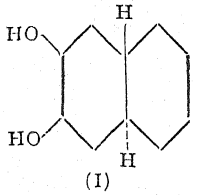
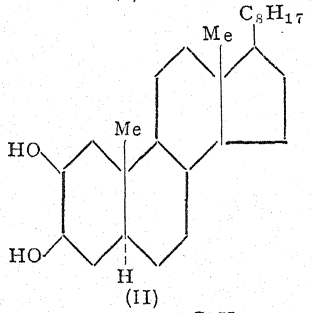
The Configuration of the C_3 Hydroxyl Group in the Digitonin Precipitable Steroids

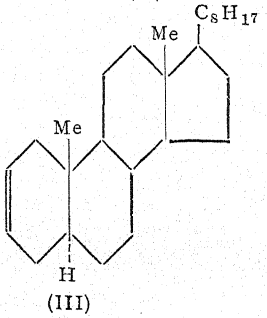
THERE are many indirect evidences to indicate that the C_3 hydroxyl group in the steroids which precipitate with digitonin, is *cis* to the C_{10}-methyl group.[1, 2] A direct and absolute proof for this appeared to be obtainable by extending our studies on the stereochemistry of the 2:3-dihydroxy *trans* decalins (I)[3] to the 2:3-dihydroxy cholestanes (II) which can exist in four stereoisomeric forms (the isomerism herein concerned being due only to the two hydroxyl groups attached to C_2 and C_3), of which in one the hydroxyl groups are in the *trans* and in the rest in the *cis* positions. So, starting from neocholestene (Δ^2-cholestene III)[4] and also 2:3-diketocholestane,[5] by adopting the same methods as in the synthesis of the 2:3-dihydroxy *trans* decalins,[3] we attempted the synthesis of the four 2:3-dihydroxy cholestanes. Recently, Marker and Plambeck[6] have reported the synthesis of a 2:3-dihydroxy-cholestane (II), m.p. 201°, by the oxidation of Δ^2-cholestene (III) with hydrogen peroxide and



(I)



(II)



(III)

similarly 2-hydroxyandrosterone and 2:3:17-trihydroxyandrostane also from Δ^2-androstenone-17 and androstenol-17 respectively, all these new hydroxyl compounds, as a class, not precipitating with digitonin. Since we are not

at present able to persue our work, we here give our interpretation of the results of Marker and Plambeck in the light of our study of the 2:3 dihydroxy-*trans* decalins.

The non-precipitability of this 2:3-dihydroxy cholestane of Marker and Plambeck with digitonin is taken by us to be due to its C_3 hydroxyl group possessing the *epi* (α-) configuration,* a view also expressed by the American authors as a possibility. The other possibility that the presence of the adjacent C_2 hydroxyl group in the above compound may interfere with the formation of the additive compound with digitonin[7] does not appear to be plausible because it has been found by Rosenheim[8] and also by Marker (personal communications to the author) that the presence of the additional hydroxyl grouping at C_4 in cholesterol, cholestanol, sitosterol and stigmasterol does not influence their digitonin precipitability. It is thus to be expected that two of the 2:3-dihydroxycholestanes should precipitate with digitonin.

We assign the *trans*-configuration to the hydroxyl groups of the 2:3-dihydroxyl cholestane of Marker and Plambeck for the reasons: (i) the oxidation of the cyclic double bond with hydrogen peroxide (in the absence of osmium tetroxide) and the hydrolysis of the cyclic oxide yield the same *trans* glycol[3] as for example in the preparation of 3:5:6-trihydroxy cholestane (m.p. 231°) from cholesterol[10] and (ii) if the hydroxyl groups are in the alternative *cis* position (with the C_3 hydroxyl group being of the *epi*form), by analogy with the behaviour of the *cis* 2:3-dihydroxy *trans* decalin (m.p. 128), the compound should isomerise on treatment with acetic anhydride,† which has not been observed.

It can be seen from the space model of 2:3-dihydroxy cholestane that in the *trans* form, the C_3-hydroxyl group, now fixed to be of the *epi* configuration, is in the *trans* position to the C_{10}-methyl group. This leads to the conclusion that in the digitonin precipitable steroids, the C_3-hydroxyl group occupies the *cis* position with reference to the C_{10} methyl group; only the two inferences drawn above by analogy have to be checked experimentally to make this proof more rigorous.

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Haffkine Institute,
Parel, Bombay,
July 29, 1939.

* We now consider the non-precipitability of gitogenin and digitogenin with digitonin as being due to the *epi* configuration of the C_3 hydroxyl groups.[7] This view appears to be compatible with the concept of Lettré[9] of the formation of additive compounds of the sterols.

† It also appears that the C_2 and C_3 hydroxyl groups in gitogenin and digitogerin are in the *trans* positions for the same reasons as in the case of 2:3 dihydroxycholestane now considered.

[1] Ruzicka, Furter and Goldberg, *Helv. Chim. Acta.* 1938, **21**, 498.
Cf. also *ibid.*, 1933, **16**, 327; 1934, **17**, 1395, 1407; 1935, **18**, 61.
Vavon and Jakubowicz, *Bull. Soc. Chim.*, 1933, **53**, 581.
Lettré, *Ber.*, 1935, **68**, 766.
Miescher and Fischer, *Helv. Chim. Acta.*, 1938, **21**, 336.
Chem. & Ind., 1939, **58**, 113.
[2] *Cf.* however, Cook, *Annual Rep. Chem. Soc. London*, 1936, **33**, 341.
[3] *Ber.*, 1939, **72**, 1381.
Cf. J. Indian Chem. Soc., 1938, **15**, 407.
[4] Mauthner, *Monats.*, 1909, **30**, 643.
[5] Stiller and Rosenheim, *J. Chem. Soc.*, 1938, 353.
[6] *J. Amer. Chem. Soc.*, 1939, **61**, 1332.
[7] Tschesche and Hagedorn, *Ber.*, 1935, **68**, 2248.
[8] Rosenheim and Starling, *J. Chem. Soc.*, 1937, 378.
[9] *Annalen*, 1932, **495**, 41.
[10] Westphalen, *Ber.*, 1915, **48**, 1064.
Pickard and Yates, *J. Chem. Soc.*, 1908, **93**, 1678.
Crigee, *Ber.*, 1932, **65**, 1770.

Heterogeneous Reaction between Chromic Sulphate and Manganese Dioxide

It has been found that when a solution of chromium sulphate is shaken with solid manganese dioxide, dichromate ions are formed in the solution. The reaction takes place as

$$Cr_2(SO_4)_3+3MnO_2+H_2O=3MnSO_4+H_2Cr_2O_7$$

The above mode of reaction has been established by estimating the amounts of dichromate ions and manganese sulphate formed and the amount of chromium sulphate used up in the reaction. It has been found that (*i*) the gram

molecules of the dichromate ions formed in the reaction are equal to those of the chromium sulphate used up and (*ii*) the ratio of the gram molecules of manganese sulphate to that of dichromate formed is very nearly equal to 3.

The reaction takes place fairly rapidly in the beginning but slows down later. The rate of the reaction increases on increasing (*i*) the mass of manganese dioxide, (*ii*) the concentration of chromium sulphate and (*iii*) the temperature, but it decreases when coarser particles are used and the pH of the chromium sulphate solution is decreased. The rate becomes very rapid when manganese dioxide in the colloidal state is used.

On plotting the values of $K_m = 2{\cdot}3/t \log a/a-x$, against $v = x/t$, straight lines are obtained which intersect the axis of v on the negative side. These results indicate that the mechanism of the reaction under investigation is probably the same or similar to the catalytic decomposition of nitrous oxide on the surface of platinum catalyst studied by Hinshelwood and Prichard.[1] It has also been found that straight lines drawn for reactions, carried out with solutions of chromium sulphate of the same concentration and manganese dioxide of particles of different sizes, determined roughly by the mesh of the sieves used, are coincident. These observations show that both b and k in the equation[2]

$$V = \left(a + \frac{1}{b}\right) K_m - \frac{k}{b}$$

are constant, as required by the theory.

Detailed results are being communicated for publication elsewhere.

MATA PRASAD.
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V. N. SHETGIRI.

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Royal Institute of Science,
Bombay,
July 7, 1939.

[1] *J.C.S.*, 1925, **127**, 327.
[2] Hinshelwood, *loc. cit.*

Effect of β-Indolyl 3-Acetic Acid and Phenyl Acetic Acid on the Growth of Some Members of the Family *Saprolegniaceae*

IT was first shown by Neils Nielson that under certain conditions of culture, a growth substance is formed by *Rhizopus suinus* and *Absidia ramosa* which influences cell-elongation in *Avena*. Later on, it was found that besides these two fungi a number of others also produced growth-substance. As shown by Kogl and Kostermans[1] this substance is β-Indolyl acetic acid which can also be isolated from urine (Kogl, Haagen Smit and Erxleben). It is a decomposition product of tryptophane. The physiological effects of β-Indolyl acetic acid on higher plants are about the same as those of auxin, but there are certain differences which may be due to the fact that it does not become oxidised so easily. It accelerates and retards cell-elongation in coleoptiles and roots, initiates growth in secondary meristematic tissues as well as formation of callus and roots and causes inhibition of bud-development. Crocker, Zimmermann, Hitchcock and Wilcoxon working at the Boyce Thomson Institute, have in recent years, shown that 32 different substances in all especially aromatic acids and esters are able to bring about a series of effects similar to those which are also brought by auxin and β-Indolyl acetic acid.

With a few exceptions, very little work has been done so far on the effect of various growth substances on the filamentous fungi. Leonian[2, 3] has shown that there are produced by corn roots and certain unicellular algæ substances of the nature of auxins which promote growth and reproduction of *Phytophthora cactorum* when added to ordinary nutrient media. Leonian and Lilly[4] tested about one hundred fungi with regard to the effect of β-Indolyl acetic acid (hetero-auxin) on their growth and came to the conclusion that the higher concentrations of this substance proved toxic and the lower ones failed to induce any stimulation. Wolf[5] studied the effect of α-naphthelene acetic acid on the growth of *Saprolegnia ferax* and *Achlya bisexulis* and found that a definite

inhibition of growth occurred in the presence of this synthetic growth-promoting substance.

In the present work the effect of β-Indolyl acetic acid and phenyl acetic acid (obtained from B.D.H.) has been studied on the growth of the following members of the family Saprolegniaceæ:—*Achlya dubia* Coker, *Pythiopsis intermedia* Coker, *Aphanomyces camptostylus* Drechs., *A. Cladogamus* Drechs., and *Thraustotheca clavata* (deBary) Humph. A synthetic medium with 0·1 gm. K_2HPO_4, 0·1 gm. $MgCl_2$, 1·0 gm. NH_4NO_3, 0·05 gm. cystin and 1·0 gm. of dextrose in one litre of distilled water was employed in these experiments. The concentrations of β-Indolyl acetic acid and phenyl acetic acid used, ranged between one part in 10 millions to one part in 5,000. The fungi were grown in scrupulously clean triplicate pyrex culture tubes each of which contained about 12 c.c. of the solution and were kept at 25° C. The relative growth of the fungi was measured from the vertical rise of the fungal colony on the third, fifth and seventh day after inoculation.

It has been found that in all cases lower concentrations (1:10 millions and 1:1 million) of the two growth substances induced no acceleration of growth, while concentrations higher than these caused a gradual inhibition, till with the concentration 1:5,000 the growth was even less than one-fourth of the growth in the controls in each case.

It is therefore concluded that these two growth substances, which have been found to stimulate growth in the higher plants, are of no value to these fungi as growth stimulants and rather inhibit the growth in higher concentrations.

The writer is indebted to Dr. R. K. Saksena for some valuable suggestions and criticisms.

M. S. Murdia.

Department of Botany,
University of Allahabad,
July 22, 1939.

[1] *Z. Physiol Chem.*, 1934, **113**, 228.
[2] *J. Agr. Research*, 1935, **51**, 277.
[3] *Bot. Gaz.*, 1936, **96**, 554.
[4] *Am. J. of Botany*, 1937, **24**, 135.
[5] *Ibid.*, 1937, **24**, 119.

Occurrence of Xenia in Pearl Millet (*Pennisetum typhoideum*) Stapf and Hubbard

The colour of the grain in the Indian varieties of pearl millet is whitish blue or bluish green of different intensities. The author, however, found two types of grain differing in colour, golden yellow and light bluish green, in a small sample of seed of an African variety he obtrained from Nawnagar in 1934. The two kinds of grain were sorted out and sown separately in two different localities at Palitana during the following season in 1935. While the bluish greens all bred true, giving only earheads with bluish green seeds, among the yellows some bred true to yellow grain, while others segregated into yellow and bluish green seeds in the same earhead. The actual segregation in nine plants given below was a rough 3:1 of yellow to bluish green.

Totals for 9 families	Yellow grain	Bluish green grain
	46,499	15,062

Close to the place where the yellow grained plants were grown, there were a few plants grown in pots of an Indian variety of pearl millet with bluish green seeds. Three months after planting when the earheads were ripening in the Indian variety of pearl millet, there were observed on the earheads of this variety a few grains of a distinct golden yellow colour. Since this Indian variety was previously known to breed true to bluish green seeds, the yellow grains occurring in them were suspected to be the result of natural cross pollination from the yellow grained type of the African millet growing nearby. At harvest these yellow grains, 41 in number, were collected and planted separately in the following year. In every case the grain proved to be of hybrid origin as the plant resulting from it produced earheads with both yellow and bluish green seeds occurring in them. The segregation of golden yellow to bluish green were in different proportions some of which were a clear 3:1, others 9:7, and still others with an indefinite 2 to 2·5:1. The genetics of the grain colour has now been worked out and it is found to involve three factors,

A paper on the inheritance of grain colour is being published separately.

The fact that a few golden yellow grains occurred in a head of an Indian variety breeding pure for bluish green, by cross pollination from the African variety and that these yellow grains later gave plants with golden yellow and bluish green seeds occurring in the same earhead indicate the occurrence of true xenia, the first of its kind observed in pearl millet.

Z. H. PATEL.

Palitana,
Kathiawar,
July 23, 1939.

A Note on *Pennisetum typhoideum* Rich. (*bajri*) affected by *Striga densiflora* Benth.

SEVERAL members of the genus *Striga* are parasitic on other flowering plants. Of these *S. lutea* is found to attack some members of the gramineæ. Among its known cultivated hosts, those of economic importance are sugarcane (*Saccharum officinarum* L.), *jowar* (*Andropogon sorghum* Hack.), maize (*Zea mays* L.), finger millet (*Eleusine coracana* Gaert.), *vari* (*Panicum miliare* Lamk.), rice (*Oryza sativa* L.) and several pasture grasses. Besides these some non-graminaceous and also a few dicotyledonous weeds act as hosts. Because of its pestilential character *Striga* has attracted the attention of workers in different countries to check its spread. Of those who have worked on *Striga* Van Buuren[3] makes a mention of having observed *bajri* attacked by *S. lutea* on the Poona Agricultural College Farm in 1915. He has illustrated the attack of *S. lutea* on *jowar* but not on *bajri*. Sawyer[2] gives a list of hosts affected by it as determined by tests in the Botanical Laboratory at Mandalay in which *bajri* (*Pennisetum typhoideum* Rich.) is included as one. He, however, does not mention having observed *bajri* being affected by *S. lutea* or any other *Striga* species in the open field. Saunders[1] in his list of hosts of *S. lutea* includes *bajri* based on Sawyer's list.

The writer has been collecting the seed of *Striga* species for the past seven years on the Poona Agricultural College Farm but has not come across a single *bajri* plant affected by them. In determining the host range of *Striga* species in the laboratory it was observed that *Striga lutea* seeds germinated when placed in contact with the roots of *bajri* but not those of *S. densiflora*. Beyond this no evidence of attack on *bajri* by either *S. lutea* or *S. densiflora* was observed in the open fields. Last year in the course of collecting seeds of *Striga*, a *bajri* field affected by one of the species of this genus of parasitic flowering plants (Fig. 1) was

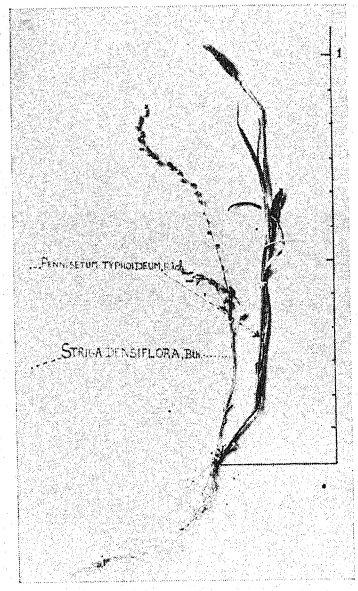

FIG. 1

Bajri (*Pennisetum typhoideum*) attacked by the parasitic flowering plant *Striga densiflora*.

observed on the outskirts of the Wadki Village, ten miles from Poona. A few of the host plants with the parasites growing close to them were carefully uprooted, brought to the laboratory and were examined. It was found that the parasite had definitely established connection with the *bajri* host (Fig. 2). The species of the parasite attacking *bajri* was identified as *S. densiflora*. Enquiries made indicate that in some parts of Khandesh, *bajri* has been affected by *Striga* to the extent of being definitely observable. If there had been attacks in the past they must have been so negligible as to have escaped notice.

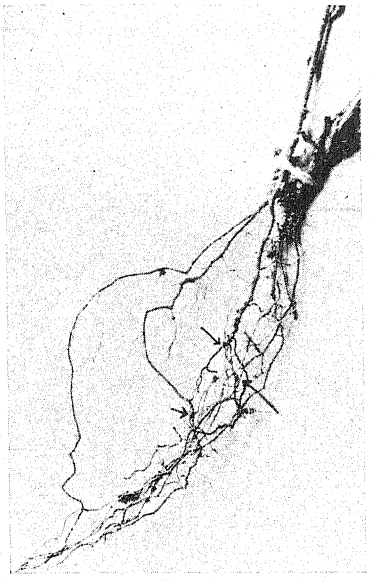

FIG. 2

An enlargement of root system seen in Fig. 1. The arrows point to places where knots have been formed due to the haustoria of the parasite (*S. densiflora*) penetrating the tissue of the host (*P. typhoideum*).

The species of *Striga* found to attack *bajri* so far are *S. lutea* as observed by Van Buuren and *S. densiflora* reported for the first time in this note. Besides these species there is a third, *viz., S. euphrasioides* and it is not known whether this too attacks *bajri*.

Several persons since Van Buuren who have worked on *S. lutea* have not definitely confirmed his observation. It is the purpose of this note to confirm not only Van Buuren's observation regarding *S. lutea* but to state that *bajri* affected by *S. densiflora* has been observed in the open on a perceptible scale during the *kharif* season of 1938.

L. S. S. KUMAR.

Agricultural College,
Poona,
June 20, 1939.

[1] Saunders, A. R., *Dept. Agri. Union of S. Africa, Sci. Bull.* No. 128, 1933.

[2] Sawyer, A. M., *Dept. Agri. Burma, Bull.* No. 18, 1931.

[3] Van Buuren (Jr.), H., *Poona Agricultural College Mag.*, 1915, **5** and **6**.

Insects as Test Animals for Nutritional and Vitaminic Studies

ALTHOUGH several investigators in the past, have employed insects for nutritional and vitaminic studies, the problem has not received any sustained and systematic attention. *Drosophila malanogastor* has been widely employed in such studies by Loeb,[1] Loeb and Northrop,[2] Bogdonow,[3] Guyénot,[4] Wollman,[5] Sweetman and Palmer[6] and more recently by Hoog.[7,8] Loeb and others demonstrated the dependence of *Drosophila* on a supply of yeast for their normal development and completion of their life-cycle. The floor beetle, *Tribolium confusum* Duval, was employed by Sweetman and Palmer[6] as an indicator animal for vitamin research. They found that a growth-promoting factor analogous or closely allied to the vitamin B complex, was necessary for the normal development of these insects. Hoog[7,8] has reared *Drosophila* under aseptic conditions and used them for vitamin investigations. He has shown the response of these insects to the vitamin B complex and also to an active factor in the unsaponifiable portion of fats, and indicated that these insects are of value in the biological assay of vitamins B_1 and B_2. Trager and Subbarow[9] have shown that the larvæ of the yellow fever mosquito (*Ædes ægypti*) require certain accessory growth factors, vitamin B_1 and B_2 which they normally obtain from living micro-organisms. While our work was in progress Rubinstein and Shekun[10] announced that "the development of the newly hatched *Galleria* larvæ can serve as a most sensitive biological test for detecting minute quantities of nicotinic acid".

It is clear from the above, that insects are capable of serving as experimental animals for researches on Nutrition and Vitamins. With the recent and spectacular advances achieved in the field of ultra-micro technique,[11] it was felt that the problem of employing insects in such studies should be viewed in an altogether new perspective. The new technique offers us

methods of estimating ultra-micro quantities of metabolic products which result in the course of nutrition studies, thereby enabling us to determine the biological value of proteins.

Among the advantages offered by insects for such work may be mentioned: (1) their short life-cycle securing economy of time and rapid replication, and facilitating the study of factors determining longevity; (2) their fecundity offering large numbers of research material and enabling statistical analysis and interpretation; and (3) their smallness of size contributing to economy in apparatus and research material.

We have commenced intensive studies on nutrition and on the assay of vitamins with the rice moth, *Corcyrus* sp. The eggs were obtained through the kind courtesy of the Entomologist to the Government of Mysore and the larvæ hatched out of these eggs have been employed in all our investigations. Unmistakable indications of their adaptability for such work, were shown by the pilot experiments which have now been carried out. The insects respond not only to certain deficiencies but also to the supplementation of these deficiencies. Insects fed *en masse* on a diet deprived of its vitamin B_1, showed a poor growth while those treated with a full diet followed their normal course of development. [See Fig. 1 (A) and (B) and Table I.]

TABLE I

Diet	Average weight of larva in mg. after 45 days. (Average of 50 larvæ.)
Normal Diet	16·6
Vitamin B_1-free diet	3·4
Whole Jowar	17·7
Alcohol-extracted Jowar ..	3·7
Ether-extracted Jowar ..	1·4

It has been found that Jowar constitutes a complete and adequate diet to these insects but when Jowar is extracted either by alcohol or by ether, the residual meal is found to be a very poor diet [see Fig. 1 (C) and Table I]. When, however, the residual meal is supplemented with these extracts, normal development is restored. These findings have established the eminent suitability of these insects for nutritional and vitaminic studies. Further work is in progress.

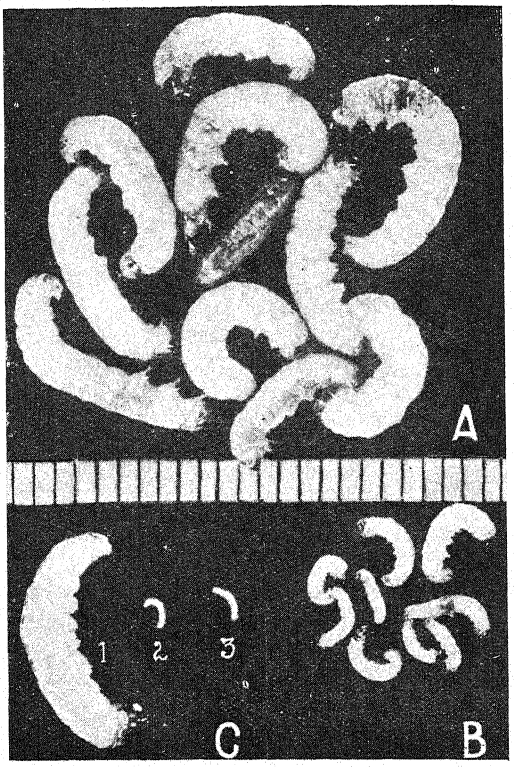

FIG. 1

A.—A representative batch of 10 larvæ fed *en masse* on a normal diet.

B.—A representative batch of 10 larvæ fed on a vitamin B_1-free diet.

Note.—Both batches taken from an *en masse* culture of 50 larvæ.

C.—(1) Larva fed on whole Jowar; (2) Larva fed on Jowar extracted with alcohol; (3) Larva fed on Jowar extracted with ether.

N.B.—All the larvæ are 45 days old. Scale : in millimetres.

Our grateful thanks are due to Mr. B. N. Sastri for fruitful co-operation, to Dr. Y. V. S. Rau for helpful suggestions and to Dr. S. A.

Kabir of the Forest Research Laboratory, Bangalore, for his kindness in photographing these insects.

B. G. L. SWAMY.
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Department of Biochemistry,
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Bangalore,
August, 14, 1939.

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1 *J. Biol. Chem.*, 1935, **23**, 431.
2 *Ibid.*, 1916, **27**, 309.
3 *Arch. Physiol. Suppl.*, 1908, 173.
4 *Compt. Rend. Soc. Biol.*, 1913, **74**, 178.
5 *Ann. L'Inst. Pasteur*, 1911, **25**, 79.
6 *J. Biol. Chem.*, 1938, **77**, 33.
7 *Zeits, Vitaminforschung*, 1935, **4**, 300.
8 *Ibid.*, 1936, **5**, 118.
9 *Biol. Bull.*, 1938, **75**, 75.
10 *Nature*, 1939, **143**, 1064.
11 Numerous publications from the Carlsberg Laboratory, Copenhagen, by Linderstrøm-Lang & his associates.

Anacardic Acid and its Derivatives as Textile Auxiliary Agents

IN a recent resumé of the chemistry of detergents published in this *Journal*, one of us[1] has referred to the marked wetting power of the sodium salt of anacardic acid, a C-pentadecardienyl salicylic acid occurring in cashew nut shell oil. The work originated from a sample of the substance and its tetrahydro derivative very kindly supplied to us by Dr. P. Pillay[2] some years ago, and formed a part of a general study in progress in this laboratory on the relation between the chemical constitution of textile auxiliary agents and their properties, such as wetting, emulsification, detergency, dispersion of calcium soaps and promotion of level dyeing. The limitations of the methods at present available for determining wetting power have been discussed elsewhere[4] and it was shown that the Herbig method, applied under the conditions standardised by Evans,[5] offers certain advantages. Using a modified form[6] of the Evans apparatus, devised by one of us and others and now being marketed by Messrs. *A. Gallenkamp & Co.*, sodium anacardate and tetrahydroanacardate gave the following Herbig figures in comparison with certain commercial wetting agents.

This apparatus, however, involving a process of centrifugal hydroextraction, is unsuitable for examining the wetting power or penetrating power of auxiliaries used in the mercerisation of grey cotton, since these have to function under strongly alkaline conditions. During the course of an investigation by Mr. N. C. Mitra of this problem and of the

TABLE I

Reagent	Herbig Number					
	1·0%	0·75%	0·5%	0·25%	0·1%	0·05%
Sodium anacardate ..	72·9	67·2	62·2	60·3	49·7	43·5
Sodium tetrahydroanacardate ..	63·4	61·2	56·3	51·8	43·4	32·7
Product V* (Sodium lauryl sulphate) ..	72·5	71·6	70·2	59·1	50·4	41·8
Product Y* (Sodium salt of oleyl N-methyl-taurine)	62·9	61·7	61·2	58·5	54·7	52·2
Product X* (sodium dialkylnaphthalene sulphonate)	80·8	76·9	73·2	58·9	48·6	37·4

(* These were used in chemically pure form).

chemical character of the reagents that possess the special property of improving the wettability of grey cotton by caustic soda solutions of mercerising strength, it became obvious that anacardic acid and its derivatives should have interesting properties from this point of view. Anacardic acid, anacardol and their saturated analogues were insoluble in strong caustic soda solutions, but a mixture of anacardic acid and cellosolve in specified proportions was miscible with the mercerising alkali and exhibited a wetting power comparable with commercial products.

The wetting power of anacardic acid is diminished by hydrogenation. A series of wetting agents have been prepared by the condensation of anacardic acid and tetrahydroanacardic acid with arylamine sulphonic acids, following the synthetical lines outlined in earlier work.[3, 7] The sulphonation of anacardic acid and its esters and the action of maleic anhydride on these products have also been studied in order to arrive at wetting agents with improved properties in various directions, particularly in regard to the ability to resist hard water.[8] In the light of the synthetic resins with base exchange properties described by Adams and Holmes,[9] the ability of resins prepared from anacardic acid and anacardol to act as organic water softeners or "Organolites"[10] is being examined. By distillation of cashew nut shell oil *in vacuo*, anacardol (decarboxylated anacardic acid) can be readily prepared in quantity, and various syntheses with anacardol and tetrahydro-anacardol as starting materials are also in progress. One example is the condensation of these phenols with ethylene chlorhydrin, followed by sulphation of the phenoxyethyl alcohol thus obtained.

While carrying out tests on the mildewing of cotton goods on behalf of local mills, a method was developed for the estimation of salicylanilide ("Shirlan") in calico.[11] The high potency of the substance as an antiseptic for sized cotton, and its characteristic substantivity enabling its diffusion from warp to weft, led us to undertake a comprehensive examination of the chemistry of textile antiseptics. The antiseptic requirement for the prevention of mildew in cotton is a specific property, of which an adequate estimate cannot be obtained by a consideration of the phenol coefficient or other assay of antiseptic power. In the present experiments the procedure adopted was to add a known quantity of the antiseptic in the form of an aqueous solution to 0·1 g. of farina, make up to 10 c.c., gelatinise in a boiling water-bath for 3 minutes, plug the tubes with cotton, sterilise in an autoclave for 20 minutes at 15 lbs. steam pressure, cool and inoculate with a culture prepared from mildewed cloth.[12] The inhibition concentration was taken as the per cent. concentration of the antiseptic in the medium at which no growth of the organism was visible after 4 days, representative values for certain antiseptics being recorded in the following table. The phenols were dissolved in the molecular proportion of caustic soda solution.

While the germicidal and medicinal properties of the oil of the pericarp of *Anacardium occidentale* are recognized,[13] and uses for the oil as a preventive against whiteants and as a dressing for leprosy, ringworm and ulcers have been stated, the interest of anacardic acid as an antiseptic for textiles lies in its constitution as a C-alkylated salicylic acid, the anilide and analogous derivatives of which may be expected to combine the antiseptic properties of "Shirlan" with a wetting power derived from its polar character comprising a hydrophilic phenolic hydroxyl and a hydrophobic long chain alkyl residue. It will be noticed from Table II that the anti-mildew action of anacardic acid is of no particular interest, but more favourable results from certain of its derivatives are indicated.

Reference to anacardic acid in a recent write-up[14] from Baroda has necessitated this note. We should also add in this connection that we are in constant touch with our neighbour, Dr. R. C. Shah, with regard to his work on the constitution and synthesis of anacardic acid and related substances, and have ensured that our

TABLE II

Antiseptic	Inhibition concentration
Phenol	0·090
o-Cresol	0·038
m- ,, ...	0·035
p- ,, ...	0·055
p-Chlorophenol	0·020
p-Nitrophenol	0·009
Pentachlorophenol	0·012
Salicyclic acid	0·020
Phenol *p* sulphonic acid	0·250
p-Toluene sulphonamide (sodium salt)	0 150
o-Hydroxydiphenyl	0·008
o-Hydroxyacetophenone	0 050
p- ,, ..	0·150
p-Hydroxyphenyl benzyl ketone ..	0 025
"Shirlan"	0·010
"Preventol"	0 002
Sodium anacardate	0·100

experiments are along parallel and complementary lines, leading to no duplication of effort.

R. C. GANDHI.
K. VENKATARAMAN.

Department of Chemical Technology, The University, Bombay,
August 7, 1939.

[1] Venkataraman, *Curr. Sci.*, 1939, **8**, 282.

[2] Pillay, *J. Indian Chem. Soc.*, 1935, **12**, 226, 231; *Proc. Ind. Sci. Cong.*, 1938, 59.

[3] Uppal, *M.Sc. Thes. Univ. of the Punjab*, 1935; Uppal and Venkataraman, *J. Soc. Dyers Col.*, 1937, **53**, 91, *et sequa*.

[4] Forster, Uppal and Venkataraman, *J. Soc. Dyers Col.*, 1938, **54**, 465.

[5] Evans, *Ibid.*, 1935, **51**, 233.

[6] Forster, Uppal and Venkataraman, *British Patent Application* No. 34810 of 1937.

[7] Uppal and Venkataraman, *J. Soc. Dyers Col.*, 1939, **55**, 125.

[8] *Cf.* Ramachandran, Uppal and Venkataraman, *Ibid.*, 1938, **54**, 520.

[9] Adams and Holmes, *J. Soc. Chem. Ind.*, 1935, **541 T**; *Brit. Pat.* 450, 308; *U.S. Pat.*, 2, 104, 501; *I. G. Farbenindsutrie, Brit. Pat.*, 489, 173.

[10] Burrell, *Ind. Eng. Chem.*, 1938, **30**, 358.

[11] Forster, Gandhi and Venkataraman, *Proc. Ind. Sci. Cong.*, 1939, 91.

[12] *Cf.* Morris, *J. Text. Inst.*, 1927, **18**, T 99; Fargher, Galloway and Probert, *Ibid.*, 1930, **21**, T 245.

[13] Nadkarni, *Indian Materia Medica*, p. 59.

[14] Patel, *J. Ind. Chem. Soc., Indl. Edn.*, 1939, **2**, 112.

Nitrite Estimation in Compost and Soil Extracts

THE object of this note is to bring to the notice of workers in the field of agricultural and biochemistry a comparatively simple and accurate method of nitrite estimation which is still unknown to many. The method was first described by Sanin[1] in Russia. The obscurity of the method is apparently due to its publication in a Russian journal which is available only to a few. A reference to the method without details, except the main reaction involved, is to be found in *Industrial and Engineering Chemistry*.[2]

Methods of nitrite estimation can be ordinarily classified under two heads, (1) colorimetric methods; (2) oxidation methods. There is also a standard gasometric method described by Treadwell and Hall.[3] This method, although accurate, is tedious and expensive. Both colorimetric and oxidation methods are inapplicable to composts and soils because of the colour and dissolved humic bodies in their extracts.

The method under notice which appears to be most suitable for coloured and humic extracts, was worked out in these laboratories and found to be satisfactory even with highly coloured extracts of composts. The only precaution necessary for coloured extracts was to dilute them to an extent which would facilitate a determination of the end point in the titration. Dilution does not affect the accuracy of the result. When a translation of Sanin's paper was obtained through the courtesy of the Imperial Bureau of Soil Science it was found that the details worked out here tallied with those given by him,

The method is based on the interaction between nitrite and hydroxylamine hydrochloride. The two reagents react rather slowly and even a prolonged contact for one hour does not give the true value, although the reaction stabilizes itself at the end of that period. Heating to about 80° C. hastens the reaction and at the same time removes nitric fumes which were found to interfere with the estimation. The reaction takes place according to the following equation

$$NH_2OH \cdot HCl + NaNO_2 = NaCl + N_2O + 2H_2O.$$

Even though the equation does not suggest the presence of nitric fumes, still every interaction is followed by the smell of nitrogen peroxide presumably due to the decomposition of small amounts of nitrous acid which is the intermediate product in the reaction. This may partly account for the slightly low recovery of nitrite upto 25 mg. and at the same time may roughly act as a guide to the presence or absence of nitrite in the sample.

Following the decomposition of the hydroxylamine hydrochloride the acidity of the solution diminishes and the titration then simply becomes an acidimetric and alkalimetric one, the successful end of which depends upon the use of a proper indicator.

The acidity of the hydroxylamine hydrochloride solution is determined by titration with a standard solution of caustic soda before and after the reaction with nitrite with phenolphthalein as the indicator. The difference between the volumes of caustic soda gives the amount of hydrochloric acid used up in displacing the nitrogen from nitrite.

10 c.c. of nitrite (5 gm. to a 1000 c.c. accurately weighed) are pipetted into a conical flask containing 10 c.c. of NH_2OH-HCl solution (10 gm. to a 1000 c.c. approximately) and the flask is heated to about 80° C. until the evolution of the gas ceases. Heating to boiling gives no advantage. The flask is then cooled and the contents titrated against 0·05 N caustic soda. The alkali equivalent for 10 c.c. of NH_2OH-HCl is previously determined. The difference between the two titrations is a measure of the acid used up in decomposing the nitrite and hence is a measure of the quantity of nitrite.

Weaker and stronger alkali upto N/10 can be used depending upon the amounts of nitrite and the individual's ability to observe the end point correctly. One drop of N/20 NaOH gives a sharp end point whereas it was not so with N/50. Weaker titres will no doubt increase the accuracy, provided the end point is properly judged.

The calculation is made according to the following formula:

$$\% \text{ Nitrite} = \frac{a \times b \times 69 \times 10}{40 \ S}$$

where a = c.c. of alkali for the whole of the sample S.
b = titre of the solution of alkali.
69 = molecular weight of sodium nitrite.
40 = molecular weight of sodium hydroxide.

Several compost extracts of various colour intensity were tried with this method with satisfactory results. Highly coloured extracts were suitably diluted and used for analysis. Known amounts of nitrites were added to composts and their extracts analysed. The recovery was as follows:—

Recovery of Nitrite added to Composts

$NaNO_2$ added	$NaNO_2$ recovered	Per cent. recovery
25 mgm.	24 84 mgm.	99·3
50 ,,	50·70 ,,	101·4
100 ,,	102·10 ,,	102 1

Hydroxylamine hydrochloride and other solutions can be safely stored over fairly long periods without any need of restandardization. The method is simple, economical and rapid.

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[1] *J. Russ. Phy. Chem. Soc.*, 1909, **41·1**, 791.
[2] *Ind. & Eng. Chem. Anal. Ed.*, 1933, **5**, 112.
[3] *Analytical Chemistry*, 1924, **2**, 700.

REVIEWS

Theoretical Electro-Chemistry. By N. A. Mckenna. (Macmillan & Co., Ltd., London), 1939. Pp. xiii + 469. Price 15*sh.* net.

The theory of inter-ionic attraction put forward by Debye and Hückel in 1923 and extended by Onsager in 1927, has led to a new orientation of our ideas with regard to the state and behaviour of ions in solution. The early successes attending the application of this theory to the process of electrolytic conduction have been followed up by further successes in other fields, in recent years, with the result that the theory is now capable of explaining almost all the properties of dilute ionic solutions, both reversible and irreversible. These developments make it incumbent on every student of theoretical chemistry to get himself fully acquainted with the theory of inter-ionic attraction and its applications at a relatively early stage of his specialised studies. The book under review will enable him to do so.

The book opens with a chapter on historical introduction to electro-chemistry, which gives a clear and lucid account of the development of the subject. This is followed by a chapter on fundamental electrical measurements, dealing with the measurement of electric current and potential difference. In the next chapter, the author introduces the general theory of conductivity, describes the methods of measuring the conductivities of solutions in detail and discusses the experimental results in the light of the inter-ionic attraction theory. The change of conductivity with frequency and increasing field strengths and the conductivities of non-aqueous solutions are also discussed at length. The two succeeding chapters deal with the other irreversible properties of ionic solutions, such as mobility, transport number, viscosity, diffusion and surface tension. The next chapter contains an outline of the principles of chemical thermodynamics and their applications to solutions. This serves as an introduction to the succeeding three chapters which deal respectively with the thermodynamical or reversible properties of strong electrolytes (osmotic pressure, solubility effect, etc.), the electrode processes and reversible cells. The topics discussed in the remaining chapters include polarisation, over-voltage, the effect of ions on the solvent molecules, ionic equilibria, hydrolysis of salts and the theory of indicators.

The book is written in a clear style throughout and is well produced. References to original literature make it a valuable guide in the advanced study of the topics discussed. It is believed that the work will prove very useful as a text-book for the university students working for the degree examination.

M. QURESHI.

Spontaneous Fluctuations of Voltage due to Brownian Motions of Electricity, Shot Effect and Kindred Phenomena. By E. B. Moullin. (Clarendon Press, Oxford), 1938. Pp. 251. Price 17*sh.* 6*d.*

The book deals with a class of phenomena which have come into prominence with the development of high gain amplifiers. In fact these phenomena came to be noticed and studied on account of the residual noises in such amplifiers, and can be studied only through their intervention. These noises were found to depend largely on the nature and the condition of the elements present in the grid-filament section of the first valve of an amplifier. The scale of the effects is very small, as in the case of Brownian movements, of which they are counterparts, and they could not have attracted attention by themselves, without the magnification available through the amplifiers.

Since their first discovery, a great deal of experimental and theoretical work has been done on the subject by a number of scientists, among whom may be mentioned J. B. Johnson, F. C. Williams, H. Nyquist, N. R. Campbell, W. Schottky and the author, E. B. Moullin, to mention only a few. The author writes with first-hand practical knowledge and subjects the material available, both theoretical and experimental, to a searching and critical analysis. He takes a cautious attitude where insufficient knowledge of the factors makes such an approach necessary. His attitude is that of a vigilant pioneer taking us through the intricacies and doubts that yet beset a study of the phenomena. Contributions by various workers in the field are fully recognised and references

are given to the original papers. Tables of results, graphs and diagrams are freely reproduced.

Coming to the treatment of the subject, the author starts with observations on the Kinetic Theory and the equipartition law, showing how this law could be applied to the fluctuations of charge or current in electric circuit elements. Experiments are described justifying such application. Expressions for mean square values of thermal fluctuations of voltage are derived and examined in the light of experimental results. Shot voltage in thermionic tubes is next dealt with, both in temperature limited and space charge limited cases. It is shown that where the thermal fluctuations and shot effects coexist, they produce their results more or less independently.

Two chapters are devoted to a close scrutiny of the working of a diode, under both temperature limited and space charge limited conditions of current, and a search is made to connect the shot effect with the thermal fluctuation effect. Interesting results arise, such as that the shot effect in a diode corresponds to the thermal effect in a resistance equal to half the valve resistance at half the cathode temperature. A critical analysis of the work of different authors is to be found here.

This is followed by similar analysis in the case of triodes and multielectrode valves under different conditions of partition of the electron stream by varied interconnection of electrodes. Chapter six deals with the phenomena of the "flicker effect" at low frequencies, the "ionisation effect" depending on presence of positive ions, and phenomena arising from "secondary emission". The last chapter deals with certain technical problems involving fluctuations, such as action of rectifier on fluctuation voltages, signal to noise ratio in coupled circuits, thermal fluctuation in cables, effects arising through vacuum photoelectric cells, "crazy contact" effects, and limitations to galvanometer sensitiveness. An appendix deals with a few papers published after the material had been sent to press.

On the whole the book is a very thorough exposition of a most complicated subject, and deserves the attention of all who are interested in electrical communication.

A. V. TELANG.

Grundzuge der Theorie ungesattigter und aromatischer Verbindungen. By Prof. Dr. E. Hückel. (Verlag Chemie, G.m.b.H., Berlin), 1938. Pp. 160. Price 6 RM.

Several chemists watch with helpless amazement the rapid inroads of the physicist with his new fledged mathematical tools, into even the favourite fields of organic chemistry. Indeed, without a considerable effort, one feels it almost impossible to follow the "geheimsprache" or code language of this new race of "quantum chemists". And yet, not even the orthodox organic chemist revelling in purely synthetic work, can feel at ease without some acquaintance with the modern developments in what may be called the fine structure of the electronic constitution of organic molecules. In particular, it is interesting to note that the striking physical and chemical properties of unsaturated and aromatic compounds are being tracked down both qualitatively and quantitatively in terms of the quantum theories.

Various attempts have been made to present these developments in a non-technical language and the booklet under notice can easily be classed as one of the successful variety in this direction. It is actually only a reprint of a *Sammelreferat* originally published in the *Zeit. f. Elektrochemie,* but the present publication in a separate booklet form will make the subject-matter more easily accessible in college libraries. In this book after a description of the pair and orbital methods of approximation to the energy of polyatomic molecules, the author deals with free radicals, and the characteristic reactions of several compounds. The limitations of the applications of the modern theories in the present form, are not underestimated, and the book serves on the whole to convey to the readers for whom it is meant, a clear picture of the modern achievements, and perhaps also of the future possibilities.

M. A. G. RAU.

Electricity Meters and Meter Testing. By G. W. Stubbings. (Chapman & Hall, Ltd., London), 1939. Pp. 216. Price 12*sh.* 6*d.*

At the present time when the laws governing the supply meters in India are being reshaped, this book comes at a very opportune moment. It deals with the subject of

meter testing in the light of the legislation introduced in the British Isle in 1936.

The book opens up with a chapter dealing with economic aspects on which various charging systems are based and gives a brief but masterly summary of the rationale of energy costing. A brief description of the various types of meters in use is followed by the discussion of methods of measurements and errors of measurements. Chapters dealing with standard and sub-standard instruments for use in the testing laboratories and laboratory equipment appear at places to be unduly detailed, since a large portion of the material dealt with in these chapters could be found in most text-books on electrical measurement. The chapters on methods of measurements and recording and of analysis of results is particularly interesting.

Mathematics has been used sparingly. It is felt that electrical engineers, in general, would prefer to have the theoretical aspects dealt with in terms of mathematical symbolism rather than have it elucidated "by verbal explanations from first principle". Mathematics, for an electrical engineer of to-day, is no more a bugbear, but the language in which he can express himself with exactitude.

The book would have acquired a greater value, had the subject-matter of design and construction of various types of meters been dealt with in a greater detail. The short list of references to books and papers, included at the end of the book, hardly justifies the editorial policy of the monograph series of which this book forms a part. Detailed references to current literature scattered throughout a book like this would enable the reader to follow up any aspects of the subject to a greater extent if so desired.

The book as it stands would, no doubt, prove useful to practical engineers who are concerned mainly with the testing of meters.

A number of typographical errors appearing throughout may, it is hoped, be corrected in the subsequent editions.

LAL C. VERMAN.

The Theory of Complexity and of Allotropy. By Professor Dr. A. Smits. (Verlag Chemie, G.m.b.H., Berlin), 1938. Price RM. 19·50.

Professor Smits's work on the complexity of phases and transformation and allotropy of phases is well known to all students of chemistry. In the present book Professor Smits gives an up-to-date exposition of his theory of allotropy and of the complexity of phases in the form in which he has developed it since his first publication on the subject. He discusses exhaustively the experimental evidence in support of his views. The book will be found very suggestive and useful to all who are interested in the complexity of phases.

J. C. GHOSH.

Aircraft Design. By C. H. Latimer Needham. (Chapman & Hall, Ltd., London), 1939. Vol. I—*Aerodynamics*. Pp. viii + 228, 144 figures. Price 13*sh*. 6*d*. net: Vol. II—*Aerostructures*. Pp. viii + 314, 160 figures. Price 16*sh*. net.

This book, in two volumes, is by a well-known authority on aeroplane construction, who has had wide experience in aero work in all its branches, piloting, teaching, design and construction. The first volume is entitled "Aerodynamics" but it is not devoted exclusively to the abstruse mathematical theory which that term is usually taken to denote; throughout the volume are numerous descriptions and practical applications of the aerodynamic laws. Aerodynamics in the restricted sense may be assumed to comprise such subjects as air flow, lift, properties of aerofoils, flight stability and airscrew theory, but in addition to this the volume contains a great deal of matter on the practical application of the fundamental theories such as arrangement of lifting surfaces, control systems, slotted wing and other devices, aeroplane performance, with valuable and interesting design figures on such matters as dynamic loading.

The second volume deals with the design proper of the structural parts and of the auxiliary parts such as the undercarriage and the control system. It also contains, necessarily, chapters on the materials of construction and their properties, properties of structures as well as a chapter each on the power unit, seaplanes and flying boats and the testing of aircraft materials and components.

The tone of the whole book is very practical, design data and concrete figures relating to subjects under discussion being given throughout, which practice always has a

strong appeal to any engineer in any branch of the subject. While the book will be keenly appreciated by engineers and students who are engaged professionally on aircraft work, it will also have a wider appeal to a large number of people who are prompted merely by intellectual interest to learn something about this fascinating subject, and the greater part of this book can be read with interest by those who have only a limited knowledge of mechanics.

K. ASTON.

Photochemical Reactions. (1) The Determination of the Mechanism of Photochemical Reactions. By Phillip A. Leighton. (Hermann & Cie, Paris), 1938. Pp. 72. Price 18*fr.*; and (2) The Photochemistry of Halogens. By G. K. Rollefson. (Hermann & Cie, Paris), 1938. Pp. 53. Price 20*fr.*

These valuable publications issued under the direction of Dr. W. A. Noyes Jr., give an authoritative exposition of the current position on photochemistry and are particularly valuable to those engaged in allied fields of research. The introductory chapter in the monograph on the mechanism of photochemical reactions, is devoted to the determination and interpretation of quantum yields and a general treatment of photochemical kinetics. In the later chapters the photo-decomposition of ammonia and of hydrazine, the photochemical synthesis of ozone and the reactions involving the halogens and the C = C bond are treated in detail with a view to illustrate the methods used and the problems encountered in determining the nature of the over-all mechanism of photochemical reactions.

The second monograph deals, in detail, with the nature of the activating influence of light on the halogens in the gaseous state and in solution. The reactions of the halogens with hydrogen and carbon monoxide as well as the well-known substitution and addition reactions are discussed. A few typical sensitised reactions are dealt with and it is shown that the so-called sensitised reactions are in reality very complex mixtures of reactions. A discussion of the role of moisture in the photochemical combination of hydrogen and chlorine would have added to the usefulness of the publication.

K. S. G. D.

The Soils of the Lusitano-Iberian Peninsula (Spain and Portugal). By Emilio H. Del Villar, President of the Mediterranean Subcommission of the International Society of Soil Science; translated into English by G. W. Robinson, Professor of Agricultural Chemistry, University College of North Wales, Bangor. (Sole Publishing Agents for all countries except Spain: Thomas Murby & Co., 1, Fleet Lane, London, E.C.4), 1937. Pp. 416. Price 40*sh.*

The above book is published in the series "The Soils of the World". The translator, in his Preface, says that this book has an importance which reaches beyond the boundaries of the region with which it deals and that it is an important contribution to the problem of soil classification and further that it must inevitably modify current ideas on soil genesis and classification. The truth of these words are fully borne out by a careful study of the book.

The classification used in the book is fundamentally the objective system which was presented by the author to the Second International Congress of Soil Science (Leningrad, Moscow) only in that it has been modified to some extent for the sake of greater amplification. According to this system, soils are classified by their own characters of stratigraphy, composition, and metabolism, taking as basis those factors which most directly affect the vegetation, namely, soluble salts, importance of the sodium ion in the absorbing complex, presence or absence of calcium carbonate, character of the humus, proportions of silica and sesquioxides in the mineral colloidal material, and the medium (aerobic or submerged) in which metabolism takes place. The soils have been classified into hydropedic, saline, alkaline, calcareous, allitic, acid-humic, siallitic, alluvial, and Gley series or grouping further into saline-alkaline cycle, calcareous cycle, sesquioxide cycle, and hydropedic cycle. Dr. Villar recognizes that when soils are classified under this system, some soils cannot, in many instances, find place under any head and says appositely that "In the natural sciences, divisions are human devices; whilst nature is continuous".

In his description of the soil types and classification on the basis of his system, Dr. Villar again and again finds cause to call

into question the older systems of classification. Thus regarding *podsol* he says, "I do not consider *podsol* 'stricto sensu' as a systematic division of the first order, but as an accentuated stage within a type of series, whose general character is unsaturated humus and not the occurrence of a podsolized horizon. Podsol should therefore be a division of acid-humic soils," again "Russian and German authors have termed podsol a zonal soil since it appears to be such in their countries. In the Peninsula, the acid-humic soils appear to be conditioned not so exclusively by the climate as by the parent material. This is one of the reasons for believing that zonality is not a proper character of soils but a geographical result, and should not therefore, be used as a basis of classification." He dismisses the division Ramann's Braunerde 'brown forest soil' as ambiguous. "In my objective system these expressions are rejected as ambiguous, since there exist forest soils and brown soils of essentially different character." Regarding Terrarossa he says, "Within the siallitic series there are also red soils which, in the Peninsula, as in other countries, have often been confused with Terrarossa. Terrarossa belongs to the calcareous series. Reifenberg has shown that the red colour is due to iron oxide peptized by colloidal silicic acid. His proof refers only to calcareous soils. But since colloidal silicic acid and not (calcium) carbonate is the effective factor in the phenomenon, I believe that explanation is equally applicable to siallitic soils, which, when their leaching metabolism is not very intense, contain also high proportions of colloidal silicic acid without necessity for the presence of carbonates to favour coagulation." Regarding the origin of saline soils what he says is of particular interest to certain portions of India, and detailed examination of profiles may show the cause of formation to be similar. Thus "The salt marsh areas of the interior (Spain) have not, as has been supposed from superficial study for half a century, a regional extension and do not result from general hydrological and climatic factors, namely, transport by water to depressions and lower levels of salts dissolved from surrounding lithological materials, and capillary rise of such salts, followed by their accumulation in superficial crusts owing to the intense summer evaporation. The actual saline patches in Spain are local phenomena of deep-seated (geological) origin, occurring with frequency in certain areas for this reason and *generally independent of the regional lithology.* In their formation climate plays a passive rôle, by not permitting the removal of salts by leaching as would happen in countries with less evaporation and more abundant rainfall. Where salinity tends to be more general it is due not to different causes, but to the longer or more intense operation of the same cause" and again later "But the antecedent fact of the formation of lithological materials capable of yielding soluble salts to leaching waters can only be attributed to deep-seated causes. The impregnation phenomena belong to the past; the activity which produced them has now ceased; and the saline lithological materials only play a passive rôle in providing leachable materials". " ..... climate then, is not the effective agent of saline formations. Its rôle is passive without ceasing to be important. In less arid climates the salts brought in by geological causes would have been subjected to leaching which would have prevented their accumulation. This is not peculiar to Spain and the explanation is of universal application. Thus in all parts of the world where there is a conjunction of tectonic depression with arid climate, saline soils are formed."

Prof. Emilio H. Del Villar in the epilogue to the above book quotes from his own book *El Suelo* thus:—

"A cultivator who does not know his own soil is like a business man who is ignorant of the capital with which he works" and continues "That which may be said of private affairs is true of public affairs. Without knowledge of the soils of a country and their distribution there is no possibility of intelligent agrarian policy in the present state of culture..... The soil map is therefore one of the fundamental necessities of a country. The more so since the study of the soils by modern methods is an expensive work which, by the great majority of workers, cannot be conducted privately. The maximum detail can only be obtained on large-scale maps, *e.g.*, 1:50,000 or 1:100,000 which would require an amount of work in exploration and mapping of boundaries only possible with numerous workers and abundant financial support."

How unlike our country where reduction in financial grants and retrenchments are the order of the day. To all who are interested

in the well-being and prosperity of our country, the preparation of a soil map at least as good as the one prepared by Emilio H. Del Villar for his country must necessarily become of paramount importance and significance.

The book consists of 416 pages of well-printed matter in bold type and is practically free from typographical errors, has 87 tables of analysis and 28 photographs of profiles, etc. It is accompanied by a coloured soil map on the scale 1:1,500,000.

N. G. CHOKKANNA.

Soil Analysis. By C. H. Wright. (Thomas Murby & Co., London), Second Edition, 1939. Pp. 276. Price 12*sh.* 6*d.*

This book is the second and revised edition of the book published by the author about five years ago. The new edition contains the same divisions into three chapters as the first edition, devoted to physical methods, general chemical methods and special chemical methods, but many of the older and less important methods have been omitted and room has been found for some new methods such as those dealing with freezing point, glass electrode, antimony electrode, inorganic soil colloids and the determination of zinc and cobalt in soils. The portions dealing with nitrogen and carbon estimations have been amplified and enlarged. The portion on the mechanical analysis of soils has been revised keeping in view the recommendations of the International Society of Soil Science in regard to preliminary dispersion of the soil. Fairly full working details of the several methods have been given. The book will be a useful addition to the library of soil analysts to whom it should form a useful laboratory companion.

B. VISWA NATH.

Text-Book of Dendrology. By William M. Harlow and Ellwood S. Harrar. First Edition. (McGraw Hill Publishing Co., Ltd., London), 1937. Pp. xii + 527; 224 illustrations. Price 25*sh.*

The field covered by the book is described in the subtitle as "Covering the important forest trees of the United States and Canada". And in the treatment of the subject, the authors have had in mind the rather specialised requirements of the forestry student whose profession, while demanding a knowledge of the important trees all over the country does not, at the same time, necessitate the elaborate taxonomic knowledge of each individual species as required by a pure Botanist.

It will thus be seen that the authors set themselves, both in the theme and in its elaboration, well-defined objectives. They have admirably succeeded and have produced a text-book likely to be the standard work on the subject for forestry students and a pattern on which similar books should be modelled for other regions. What a boon it would be if a comparable text-book could be produced to embrace Indian forest species!

The "Text-Book" is provided with an Introduction giving in broad outline the aim and methods of the sciences of dendrology and taxonomy. The authors, instead of pedantic discussions on such distinctions as "Trees" and "Herbs" adopt the more useful if less exact borderlines of practical utility to the forester. The introduction is followed by sections on "Gymnosperms" and "Angiosperms". Each species carries an account of its "Distinguishing characteristics", "General Description", "Range" (again a concession to the forestry student) and "Botanical features". The text is illustrated with unusually good photographs bringing out all the essential detail (the photograph on p. 297, Fig. 129—Fruit and leaves of beaked Hazel nut × ¾ is typical of the excellence of the reproduction). A modest Glossary, some "selected References" and a good "Index" have been provided. (It is noticed that the term "appressed" frequently used in the text fails to find mention in the Glossary.)

The *Text-Book of Dendrology,* although dealing with species largely exotic to India would be a useful addition to the Forest and Botanical Sections of our Libraries as it would also be of special interest to those engaged in the comparative Taxonomy and Dendrology of forest trees. The book is a worthy addition to the "American Forestry Series" and the authors as well as the publishers are to be congratulated on maintaining the high standard set up by the earlier numbers of the series.

M. N. R.

The Plant Alkaloids. By T. A. Henry. (J. & A. Churchill, Ltd., London), 1939. Pp. 689 + xvi. Price 42*sh.*

The third edition (1939) of this well-known treatise on the chemistry of the plant alkaloids is a most welcome addition to

scientific literature. The book is divided into thirteen chapters and the index is helpfully complete. Since the publication of the second edition (1924) the investigation of alkaloids has progressed with great vigour, resulting in the creation of a vast amount of knowledge. To do justice to this and at the same time to avoid the book developing into a bulky volume, details about the estimation of alkaloids and pictorial illustrations have been deleted from this edition. An important omission in the subject-matter is the discussion on the purine group, and however justifiable the omission may be from the point of economy of space, one misses it very much.

The structure of many alkaloids are known with certainty and a good many of them have been synthesised. The analytical development is very carefully and concisely described and all the well-known syntheses are described in a helpful manner. The methods developed by Schopf and Hahn for the synthesis of alkaloids under conditions approximating to those existing in the living plant are described in general in the introductory chapter and in greater detail in the text.

With the synthesis of nicotine it was assumed that tobacco would provide no more thrills, but the work of Spath and his collaborators has shown that tobacco contains a number of subsidiary alkaloids. The chemistry of lupinine is fully described, and reading through these pages gives the conviction that since the groundwork has been so skilfully cleared by Clemo and his collaborators, the alkaloids of Senicio, Trichodesma and Helitropium, now grouped under alkaloids of unknown constitution, may soon be shifted to a place higher up.

The reviewer cannot help remarking that the formulæ are printed in a manner which is not very attractive. Trying to economise space by adopting the present method of printing formulæ has resulted in ambiguity in certain places. For instance on page 316 the amino-group in tetrahydro-*iso*-quinoline (Formula 5) is printed as part of the ring. Apart from such very minor defects the book is very clearly printed and attractively bound. There is no doubt that every library should possess a copy and no worker in the field of alkaloid chemistry can afford not to own a copy. B. L. MANJUNATH.

Intermediate Solid Geometry. By Brij Mohan. (Mohan & Co., Muradbad), 1938. Pp. 120. Price Re. 1-4-0.

The book is intended for the use of students studying in the Intermediate class and the treatment of the subject is not very different from that in *Hall and Stevens' School Geometry*, Part VI. The author claims to supply the long-felt need of supplementing every proposition with a variety of examples, the working of which is necessary for every student to get a clear conception of the subject. While the insertion of a certain number of theoretical exercises under every proposition has certainly added to the novelty of the book, the almost complete omission of numerical exercises in the beginning is not, after all, a very happy feature. A good number of numerical exercises, even before the commencement of the treatment of solids, ought to have been introduced to familiarise the student with, for example, the ideas of (*i*) angle between two planes, (*ii*) a line and a plane, etc., which occur very frequently in mensuration. A novelty in the arrangement of propositions could also have been welcome—the theorems on parallels might have preceded the theorems on perpendiculars. While dealing with the chapter on Sphere, ideas of latitude and longitude could also have been given clearly before attempting exercises demanding their knowledge. Barring some of these drawbacks from which not many books are free, the book can conveniently be used for teaching in Intermediate classes. N. R.

Trigonometry. By Hughes and Muller. (John Wiley & Sons, New York; Messrs. Chapman & Hall, Ltd., London). 1938. Pp. 189 + 79. Price 7/6.

This attractive, excellently got-up textbook will be welcomed by the beginner of Trigonometry as a very useful introduction. More importance is given here to the numerical aspect of the subject than is done in the usual text-books. We believe, with the authors, that the student will interest himself more in the subject by being introduced to the immediate applications of the formulæ he learns than by mere pursuit of the theory. The chapter on the Spherical Triangle and the Logarithmic and other Tables at the end admirably serve the purposes for which they are intended. B. S. S.

The Evolution of the Text-Book

Introductory College Physics. By Blackwood. (John Wiley & Sons, Inc., New York, Chapman & Hall, London), 1938. Pp. 47. Price 17*sh.* 6*d.*

TO be called upon to review an elementary text-book is at once an easy and a difficult task. It is easy, if the conventional short notice is all that is required. One studies the table of contents, occasionally glancing at the book itself to see how the familiar subject-matter is presented. One may actually read a chapter here and there to discover whether the author has a reasonable style. Consideration is given to the printing, binding, and (last but not least) the published price, after which the reviewer, according to his taste in text-books, either solemnly warns the scientific public against the pernicious influence of the work in question, or commends it to them as a shining example of what a text-book ought to be.

It may be observed first of all that the volume now under review passes such tests as these. It is to all appearances the work of a diligent and able author, excellently produced by the publishers, and, considering everything, not unreasonably priced at 17*sh.* 6*d.* But one is tempted to take the opportunity of enquiring a little more deeply into the whole matter. What, after all, is a "text-book", and by what canons of judgment should it be appraised? This is a difficult question to answer, but text-books are in many ways so important that it is worth taking a little time to consider such a singular by-product of the modern age.

The scientific text-book must be classed as a relatively modern development, belonging to the past century or so. In the early days of science there were no text-books to mediate between the mind of the creative thinker and that of the student. The student learned directly from the teacher to whom he attached himself, or from the writings of the masters, which were in no sense text-books. Lucretius' *De Rerum Natura* is not a text-book, neither is Galileo's *Dialogue on the Two Chief Systems of the World,* nor Newton's *Opticks,* nor Faraday's *Experimental Researches.* Even Maxwell's *Treatise on Electricity and Magnetism* is not a text-book in the modern sense of the term. These works are rather store-houses, containing wisdom and knowledge which the author has garnered over a long period of years. They record the author's mind, and are not primarily manuals of instruction for the student. Treasures are gathered in from every quarter with evident enthusiasm. Thus Maxwell, in 1855, writes to William Thompson: "I do not know the Game-laws and Patent-laws of science. Perhaps the Association may do something to fix them but I certainly intend to poach among your electrical images".[1]

These works, and others like them at the present day, are, in the truest sense of that much-abused word, 'literature', and are of permanent value. The text-book of modern days is usually not literature and does not pretend to be. The material is mostly second-hand, selected, often enough, to agree with an external and ill-assorted list of topics known as a syllabus, and, most baneful of all, it is too obviously 'intended for' someone. True literature is not 'intended for' anyone. One cannot imagine on the title-page of 'Hamlet'—"Intended for students of the Inter Arts", however much the hack commentator, who lowers Shakespeare's greatness to a level suitable to our intelligence, may wish it there.

The text-book writer, therefore, necessarily works against great odds. He cannot follow his fancy, nor, often, his better judgment. He must consider his work as a commercial proposition. He is in the market with his wares and they must be saleable. If the public prefers hoary fallacies, the truth will be unpopular, and must either be avoided or suitably disguised. He must remember that his reviewers may be staid and old-fashioned, but their words will be weighed in gold. If he wants his book to sell, particularly in an examination-ridden land like India, the book must contain the syllabus, the whole syllabus, and nothing but the syllabus. His illustrations must be the official illustrations, his definitions the inaccurate formularies honoured by long usage. Otherwise ponderous professors will write to him: "Your book is of no use to me, it does not cover the syllabus, you have not distinguished the three kinds of lever". The whole stock-in-trade of traditional scientific pedagogy must be there, and nothing else.

And so it comes about that India at the

[1] *Origins of Clerk Maxwell's Electrical Ideas,* Larmore, p. 18.

present time is flooded by books which do cover the syllabus, but which ought themselves to be covered by six feet of good earth. For this reason we do well to examine books which come to us from abroad, such as this *Introductory College Physics* by Professor Blackwood of Pittsburgh. One gets the impression that the evolution of the text-book has entered on a new and more interesting phase in recent years. There is evidence of a change of purpose. The older text-books, even the good ones, were dry and dull compendiums of information. The newer kind seek to stimulate the student's interest and enthusiasm, and are sedulously careful not to quench any spark of natural curiosity which the student may still retain. Professor Blackwood is an enthusiast for the new method, and indeed remarks: "The first requirement of such a course is that it shall stimulate the interest of the general student". Maxwell would have agreed with this; when he began Electricity he wrote to Thompson: "Suppose a man to have a popular knowledge of electrical show experiments and a little antipathy to Murphy's Electricity, how ought he to proceed in reading and working so as to get a little insight into the subject....?"[2] The objectionable Murphy has passed into the limbo of forgotten things, but his successors are still with us.

Here, then, is a criterion of judgment. Does the book interest, stimulate, and inspire? This is of infinitely more importance than the table of contents, and several recent publications come to mind which are admirable when judged by this criterion. The thing is achieved in a variety of ways. Firstly there is a wealth, some might say a superfluity, of illustration. On page 61, Prof. Blackwood has the old problem of the monkey hanging on a rope, which passes over a pulley, the monkey being balanced by an equal weight on the other end of the rope. What happens when the monkey climbs the rope? This engaging problem is accompanied by a life-like delineation of the monkey himself, solemnly contemplating his image in a mirror. One may not admire the monkey, but one cannot help admire the enthusiasm which put him there. And so throughout the book everything is illustrated that can be illustrated, and many of the diagrams and photographs are admirably suited to their purpose.

The second way of arousing interest is to look for the applications of physics not so much in the time-worn examples of the older writer but in things more closely related to the life of to-day. So the automobile (more familiar to us as a 'motor car') is pressed into service to provide an almost unlimited number of illustrations in all fields of Physics. The clutch and brakes illustrate friction, the transmission and the gear box make clear the principles of mechanics. The engine is an excellent piece of thermodynamics, and most of what a student needs to know about electric currents is exemplified in the ignition system. Even optics finds applications, as in the use of polaroid discs to avoid glare. Another such example is that of the refrigerator, which illustrates the conditions governing the transfer of heat. The treatment in this instance, though brief, is particularly clear and instructive.

The third development, likewise exemplified in this book, is that the author permits himself (to borrow a phrase of Eddington's) to talk "more or less like a human being and not like an Act of Parliament". The sterner critics of an earlier age would have regarded this as an unpardonable lapse. Undoubtedly it can be over-done, but dignity of language is not incompatible with freshness, and even vivacity. So, comparing the common and scientific notions of work, Prof. Blackwood remarks: "A golf caddy is 'working' when he stands idly while the perspiring player tries to hit a golf ball". One feels that Murphy, to whom Maxwell conceived such an antipathy, would never have permitted himself such a sly remark. But it makes the book live for all that. The language throughout is clear and vigorous, but one may perhaps note that the American idiom occasions difficulties now and again to the foreigner. The Indian student might be puzzled to know who the ten 'sophomores' are who apply a force to a rope on page 11. And, to the uninitiated, a pleasing flavour of mystery attaches to such a problem as "In knocking out flies, a baseball's speed changed from 0 ft./sec. to 80 ft./sec. in 1050 sec. What was the average acceleration?" One wonders for a moment what the flies have to do with it.

In conclusion, one or two criticisms may be permissible. One would like to see the hackneyed phrase 'mass is the quantity of matter in a body' die out entirely, especially as it happens to be untrue. In his treatment of specific gravity, Prof. Blackwood very properly recognises the distinction between

[2] *Origins of Clerk Maxwell's Electrical Ideas*, Larmore, p. 3.

specific mass or density, and specific weight or weight per unit volume. The latter he terms weight-density, or (in a footnote) weightivity. Surely it would be better to use the term specific gravity itself in its proper sense of weight per unit volume. By this means extra nomenclature is avoided, and a long-standing confusion is removed. German writers (Westphal, Tomaschek, etc.) already follow this practice, but the dead hand of tradition still keeps it out of the English books.

A further criticism might be that in ranging over the whole field of Physics, including very recent work, the treatment is often rather summary and sketchy. The answer is, of course, that an exhaustive treatment is not intended. One cannot blame a book for not being something which it does not pretend to be. Still, it is undoubtedly over-concise in places. There is also a distinct tendency for new ideas to slip in without proper definition, merely on the strength of some analogy, and a little more exactness at these points would not be incompatible with the purpose of the book. Torque, Rotational Inertia and Electrical Resistance are examples of this.

There are one or two small errors of fact, and a few printing errors, which perhaps are almost inevitable in a first edition.

When all such criticisms have been made, it remains true that the book is an admirable introduction to Physics, for all except those whose heads are buried in the sands of tradition. But whether it is likely to be read much in India is open to considerable question. For the students in our universities, alas, read for the most part only what is prescribed, and a book which has such a flavour of originality is unlikely, one fears, to be brought to the notice of those who need it most.

H. J. TAYLOR.

Theory of Statistical Estimation

THE fundamental stages in a statistical appreciation of a problem are, its specification through means of a hypothetical population, the distribution, particularly of the statistics which we put forward as estimating our parameters, and finally the problem of estimation itself. While great advances have been made in each of these aspects, there is no doubt that the most striking progress in recent times has been in the researches on the theory of estimation. The notable contributor to this progress is Professor R. A. Fisher himself who chose, quite naturally, the statistical theory of estimation for his Calcutta University Readership Lectures, 1938, "an orderly presentation of the material in book form" having been brought up by Professor Mahalanobis and his colleagues at the Calcutta Statistical Laboratory.

We seek in the problem of estimation the exact properties of a population from its practical model, the sample, and it is inevitable therefore that uncertainty or probability, should attach to all operations from the very beginning namely from even the selection of the sample. The problem of obtaining presumable values was attacked as long ago as 1763 by Bayes, whose theory based upon the "principle of insufficient reason" supplies one answer, though an insufficient one, since the assumed constant probability of a parameter falling within any interval of fixed size is *not* a probability of the kind related to the empirical law of large number. Gauss-Markoff's ideas implied in the "best unbiassed estimated" later adumbrated is one result of a search for something better than the principle of insufficient reason. But the chief difficulty in this method as Dr. Neymann says, is our sophistication in taking as the best what is called the best. Undoubtedly great advances have since been made and the new principle of maximum likelihood estimate, originally due to Karl Pearson himself, and later refined by Professor R. A. Fisher now holds the field. Its chief justification lies, as even the justification for Markoff's unbiassed estimates lies, in that, under certain limiting conditions, when all the observations are mutually independent and their number n indefinitely increases, then it becomes less and less probable that the *m. l.* estimate will differ by so much from the parameter that is being estimated. Dr. Fisher's lectures to the Calcutta University reviews this position, in particular in sections 6, 7 and 8 of these lectures. His argument is as follows:—

"If, then, we disclaim knowledge *a priori*, or prefer to avoid introducing such knowledge as we possess into the basis of an exact mathematical argument, we are left only with the expression

$$\frac{n!}{a!\ (n-a)!}\ x^a(1-x)^{n-a}$$

which, when properly interpreted, must contain the whole of the information respecting x which our sample of observations has to give. This is a known function of x, for which, in 1922, I proposed the term 'likelihood'; in view of the fact that, with respect to x, it is not a probability, and does not obey the laws of probability, while at the same time it bears to the problem of rational choice among the possible values of x a relation similar to that which probability bears to the problem of predicting events in games of chance. From the point of view adopted in the theory of estimation, it could be shown in fact that the value of x, or of any other parameter, having the greatest likelihood, possessed certain unique properties in which such an estimate is unequivocally superior to all other possible estimates."

On p. 29, he enunciates (and also supplies a proof of) the proposition.

Proposition: Of the methods of estimation based on linear functions of the frequencies, that with smallest limiting variance is the method of maximal likelihood, and for this the limit in large samples of $\frac{1}{n\mathrm{V}}$ is equal to i.

His conclusion, if it is at all possible to state that briefly, is probably best stated in his own words.

"The problem of estimation is to find from the sample point the most appropriate point on the curve of expectation. Thus every method of estimation is virtually equivalent to dividing up space into what may be called equistatistical regions such that every sample point on the same region leads to the same estimate. The criterion of consistency then simply states that the equistatistical region leading to any estimate of θ should actually cut the curve of expectation at the point corresponding to this value of θ. Efficient statistics have the peculiarity that the equistatistical region corresponding to such a statistic cuts the curve of expectation at right angles in the transformed space. The maximal likelihood solution is unique in that, in addition, its equistatistical region is linear. The equistatistical regions for minimum are not linear and touch the maximal likelihood regions on the curve of expectation."

In his last lecture there is a brief account of the manner of utilisation of the information recovered by ancilliary statistics, but the main centre of interest in his lectures lies in the statistical theory of estimation itself. Now it is well known that in any practical example the problem facing us is what value shall we take as *the* value of the parameter, and I am afraid we do not have an unequivocal guidance in such difficulty. Let us say, we are equal to the arithmetical labour involved in calculating both the Markoff best unbiassed estimate, and the Fisher m, l, estimate, and if these two do not agree, which are we to choose.

The following extract from the discussion that followed a Conference held in Washington in April 1937 at which Dr. J. Neyman dealt with statistical estimation (published in mimeograph by the U.S. Department of Agriculture, 1938) may not be irrelevant in this connection.

"Mr. Wallis: Doesn't Fisher claim that maximum likelihood solutions will always be minimum variance solutions also? I thought that Fisher claimed that he would get the 'best' estimate by the method of maximum likelihood.

"Dr. Neyman: I am aware of these claims. However, the proofs advanced by Prof. Fisher to support them were not considered satisfactory by many mathematicians and recently several interesting papers have appeared on the subject. As a result, many of Fisher's statements partly in a modified form and under certain limiting conditions, proved to be correct. I do not remember whether the particular claim you mention was found correct or wrong, but I will quote here papers by Hotelling, Doob, Dugue and Pitman, where you are likely to find the answer.

"But my point is that the question whether the variance of the m, l, estimate is minimum or not is not relevant from the point of view of the goodness of the estimate itself. In the above example, the variance of g is smaller than that of g_1, but does this circumstance prove the absolute superiority of g over g_1?"

It is very difficult to get a connected account of the Theory of Statistical Estimation except by wading through a number of periodicals but this brochure supplies a long-felt want.

We look forward to Professor R. A. Fisher to analyse with his characteristic powers of rigour and insight to further place the whole of this theory on firm and practical lines.

K. B. MADHAVA.

Theosophy and Science Meet

Where Theosophy and Science Meet—III. From Humanity to Divinity. Edited by D. D. Kanga, I.E.S. (Retd.). (Adyar Library Association, Adyar, Madras, India), 1939. Pp. 260. Price Rs. 2-4-0.

IN the course of my review of the first *two* parts of this undoubtedly stimulating series of monographs, I had pointed out that in view of basic fundamental differences between laboratory science and Theosophy (in the sense of knowledge of God and all it involves and implies) in investigational procedure and methodology and in the goal contemplated, a meeting between the two would not be productive of any good either to Science or to Theosophy, and a careful study of the *third* volume or part, now under notice, only further strengthens me in the conviction that when Science and Theosophy are detected in the act of kissing, the kiss is bound to be the kiss of Judas culminating in a betrayal of both. The progress of evolution on this planet from "Humanity to Divinity" (the *terminus ad quem* still lies lost in misty horizon) is perhaps the subject-matter of this part. The volume opens with a contribution by Therese Brosse on "Physiology". "Individualism and Functionalism" would describe the "trend of modern physiology, with reference to the hierarchy indicated by the "humoral, autonomous, and the voluntary" levels. In reference to the pituitary gland, it is claimed, that "recent discoveries of physiology" contain "some vindication for the contentions of Theosophy" (p. 20). The inevitable vitamins A, B, C, D and E are mentioned, and the author's conclusion is "Theosophy should co-operate with Physiology...." (p. 27). (2) J. Emile Marcault writes on "The Etheric Double". What is it? "It is the mediating principle between Karmic heredity of the evolving Ego and its physical vehicle" (p. 31). Modern Science has discovered "an electric organization lining up the material organism....electro-structure" (p. 34). Quite simply, the "electro-structure, highly organized electric body *is* the etheric double" (p. 38). (3) Edith F. Pinchin writing on "Mythology" refers to the "seven keys", and to the three schools of modern mythological research, *i.e.*, the Anthropological, the Psycho-analytical, and the Sociological schools, and concludes with an Appendix on the story of the Bridge Bifrost in Norse Mythology. (4) A. G. Pape sums up modern anthropological conclusions reached in the year of grace 1936, by European investigators, and by those in the U.S.A., and seeks to maintain that the Plan of Evolution "postulated" by Theosophy is most needed in Anthropology. (5) B. L. Atreya's contribution on "Philosophy and Theosophy", contains a brief survey of the different systems of European Philosophy and the Indian *Darsanas*. (6) That modern Psychology is slowly struggling towards the viewpoint of Theosophy is the conclusion arrived at by L. J. Bendit. (7) Viswanath Keskar writing on "Yoga" sums up the essentials of the theory and practice of the technique of Yoga. The Editor in his Epilogue maintains that "There is everything to gain and nothing to lose in this collaboration" (p. 236) between Science and Theosophy, and that a correlation "between Philosophy, Science and Religion, is necessary".

From the fore-sketched summary, it must be obvious that the different contributors have summed up, in some cases admirably, the conclusions arrived at by the Sciences as the result of experimental investigation. For this part of their performance, I have not merely no quarrel with them, but, have profound admiration which many of your readers will easily and readily share. When the other—doubtless the more important—part is examined, only vague and hazy lines of parallelisms are drawn between Sciences and Theosophy, with no attempt at scientific verification. Consider for instance, the doctrines of localization of cerebral centres, and the doctrine of conditioned Reflexes on which more and more light is still being thrown with advancing researches and investigation. In the extensive mass of theosophical literature, one will find, to be sure, some vague and hazy reference to glands and vitamins, to levels and strata of consciousness and concepts and phenomena like those, and from these references to demonstrated truths of modern sciences it is indeed a far, far cry. Thus, Theosophy's "postulates" in regard to "Physiology" are mentioned. But, "postulates" are not demonstrated truths or verified laws. Of course, every science is bound to have its own postulates on the foundations of which its superstructure must stand erected. A postulate ill-assorts with a demonstrated doctrine. I grant for the sake of argument that Theosophy has its own set of

verified truths, but, the striking fact is that "verification" in Theosophy is not verification by methods of qualitative analysis and quantitative measurement known to sciences.

Be that as it may, one must refuse to believe that the "Prana-mayakosa" is the "etheric double". The well-known Upanishadic view is that the self (not yet grappled by the methods of sciences) is enveloped by *five* sheaths — Anna-maya, Prana-maya, Mano-maya, Vijnyana-maya and Aananda-maya. Every sheath has potentiality of rebirth, and the outcome of previous existence. This is a metaphysical doctrine. The Yoga-program is intended to enable one to escape from the enmeshment of these envelopes. Beyond the fact, that the nerve-impulse is electric in character, nothing has been established by modern sciences. The etheric double falls far short of the metaphysical ideal of the Upanishads, and I am not quite sure if the scientifically trained conscience of the laboratory worker would be tempted or persuaded to sing hallelujas in celebration of its glory.

The articles or monographs on "Philosophy" and "Yoga" are very disappointing indeed. That the world is at present looking towards India for "light and inspiration" is either an imbecile's illusion or political propaganda of narrowest nationalism. "It is needless to say that there is hardly any difference between the outlooks of the Vedanta and Theosophy", and "In Theosophical teachings we also find all that is great in Indian wisdom" (pp. 148 and 161) are uncritical verdicts based on superficial similarities. I shall put a direct question— Advaita-Vedanta recognises as its vital truth the doctrine that Brahman is the Absolute— attributeless (Nirguna-Brahman). Does Theosophy admit this? The summary of Advaita-Vedanta on page 145 is defective. A Creator is spoken of. It should be explained that this Creator is a lower Brahman! Does Theosophy believe in *Two* Brahmans admitted by Śankara?

I do not very much mind if the term "Jnyana" is wrongly printed (p. 178 for instance) but, I must protest against the elevation of the *Bhagavad-Gita* into "the greatest authority on Yoga" (p. 77). Nor am I able to understand why the perfectly flawless division of Yoga, into Mantra-Yoga, Laya-Yoga, Hatha-Yoga and Raja-Yoga is confused with the Gita-account.

No one can be more anxious to vindicate the prestige of ancient Indian culture than I am. But, I must rather hesitate to argue that because, mention is made in the *Ramayana* of "Vimana" civil aviation was quite an ordinary and familiar phenomenon in those days. In the Editorial Epilogue emphasis is laid on collaboration between science and theosophy, between science, philosophy and religion. Collaboration, negotiation, treaties, Round-Table Conferences and attempts and amenities in that line should be among equals. Nothing succeeds like success. Laboratory sciences are to-day successful. Success-intoxicated Science is not anxious to come to terms with Theosophy. I must refuse to live in a Fools' Paradise hugging the illusion that Science is genuinely anxious to take advice from Theosophy. Rather nervousness and neurotic flutter are visible in Religion and Philosophy bewildered by the success of Science. I take it therefore, Theosophy is anxious to get recognition at the hands of Science. It remains to be seen. As the result of the kiss of Judas, I do not pretend to be able to predict, which party will perish in the bargain—whether Science or Vedanta! It is better both keep separate without shaking hands and kisses of Judas. Then both would live. Nervous Theosophy may coquette with sciences. Vedanta stands grounded on the Rock of Ages wedded in happy harmony to Truth, Beauty and Goodness.

R. NAGA RAJA SARMA.

OBITUARY

Dr. Walther Horn (1871–1939)

IN the afternoon of the 10th July 1939, Dr. Walther Horn, Director of the Deutsches Entomologisches Institut der Kaiser Wilhelm Gesellschaft, Berlin-Dahlem, breathed his last in his sixty-eighth year. The brief intimation of his death received by Dr. Hem Singh Pruthi, Imperial Entomologist, makes no mention of any illness but it has been evident to those, in touch with the Institute at Dahlem, that, of late, Dr. Horn had been keeping indifferent health.

Dr. Horn's contributions to entomology cover a period of nearly half a century and they are published in journals of at least three continents and in as many languages. By far the major part of his work deals with the systematics or taxonomy of Cicindelidæ, a group of insects popularly known as tiger-beetles and to the study of which he devoted practically his whole life. To-day, there will be few entomologically-known localities in the world, some part, at least, of the Cicindelid fauna of which Dr. Horn did not study, describe or record and the present knowledge of the taxonomy of this group of insects is almost exclusively based on the numerous papers contributed by him on this subject.

Essentially a systematist, Dr. Horn held very definite views on the scope and development of systematic entomology. He made no distinction between systematic and taxonomic work. If systematic entomologists could be divided into 'lumpers' and 'splitters', he certainly could not be considered to belong to the latter category. He was appalled by the number of insect species already named when probably the whole known insect fauna of the world did not exceed, in his opinion, ten per cent. of that actually existing. In an address to the Fourth International Congress of Entomology held at Ithaca in 1928, he gave forcible expression to his views on this question and, for the sake of simplifying work in future, even went so far as to suggest a tentative scheme of dividing insect taxonomy into two divisions: primary, in which the taxonomist will be concerned only up to the major groupings in a genus—"species-complexes", consisting of a number of closely-allied species grouped together, rather than species, and, secondary, in which the work will involve the division of species-complexes into lower ranks—species, sub-species, aberrations, etc.

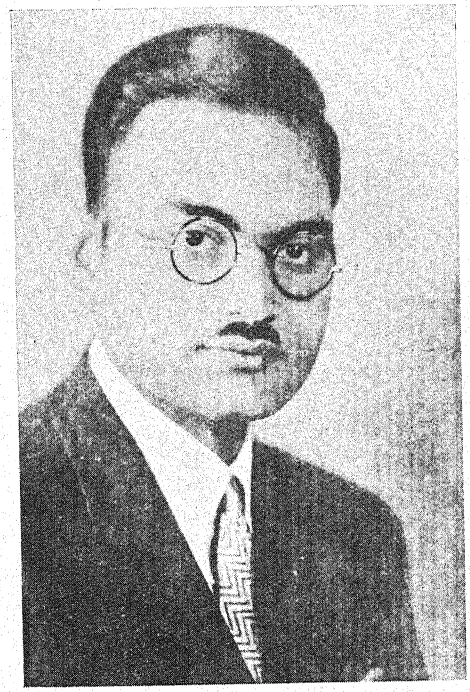
It will be impossible to cite here even the important papers of Dr. Horn but a reference may be made to one of his early publications in collaboration with Herr Sigmund Schenkling, who preceded him as Director of the Deutsches Entomologisches Institut. This was the revised and enlarged edition of Hagen's *Bibliotheca Entomologica,* which dealt with the world literature on entomology up to the end of 1863 to which the authors added no less than 7,929 articles not listed by Hagen, thus bringing the total of papers cited to 25,229. They also showed that 3,326 authors who had written on entomological subjects prior to 1863, had been missed in Hagen's publication. Two other notable reference publications by Dr. Horn were the volume on Carabidæ-Cicindelinæ in the series *Coleopterum Catalogus* published by Junk (1926), and volumes on Carabidæ-Cicindelinæ in *Genera Insectorum* published by Wytsman (1908–15). Dr. Horn had also been editing, in collaboration with his colleague, Dr. Hans Sachtleben, the three well-known German periodicals: (1) *Entomologische Mitteilungen*; (2) *Arbeiten uber morphologische und taxonomische Entomologie*; and (3) *Entomologische Beihefte aus Berlin-Dahlem.*

Dr. Horn's views on some general questions relating to entomology were also very thought-provoking and should be more widely known. For instance, he was not a great believer in the method of applying mathematical formulæ to biological work because of the various complex factors affecting living organisms, and, hence, of the probability, that what may be sound mathematically may not always be practicable biologically. On the status and functions of an entomologist, he expressed himself very clearly. An entomologist, he said, must be determined by reference to the motive actuating his work and not merely if he happens to work on insects to elucidate problems of genetics or evolution. In other words, an entomologist is one who studies insects for their own sake and not to contribute to some other branch of the biological science.

Dr. Horn had been associated with the Deutsches Entomologisches Institut since pre-war days. He was a prominent figure at and contributed papers to, all the seven international congresses of entomology so far held. He was keenly sympathetic towards entomological organisations and workers in other parts of the world. Early in 1934, when the present writer was working at the Deutsches Entomologisches Institut, he seemed greatly concerned at a possible reduction of the staff of the Indian Museum at Calcutta, due to financial stringency, a proposal to which effect he had heard of shortly before. 'The staff should be increased rather than decreased', he said, 'because in my opinion they are doing most useful work'. Dr. Horn was a quiet and unassuming gentleman, rather frail in figure but actively interested in entomology and entomologists, an interest which now and then came forcibly to the surface and expressed itself in a few pithy sentences. To the Indian entomologists visiting his laboratory in the picturesque village of Dahlem, his help was always as unstinted as his welcome was warm. Dr. Horn's death will be greatly regretted by entomologists all over the world. K. B. LAL.

Dr. P. N. Ghatak (1902–1939)

DR. P. N. GHATAK of the Department of Botany, Calcutta University, passed away prematurely on the 14th of July last. Dr. Ghatak was born in the year 1902 in the village Hashail in the district of Dacca, Bengal. He received his early education at Dacca and graduated with honours in Botany from the Presidency College, Calcutta. In the year 1927 he obtained the M.Sc. degree in Botany of the Calcutta University and worked as a Lecturer in Botany for some time in the Presidency College, Calcutta, prior to his departure for England in 1929. He started research work in Mycology at the Imperial College of Science and Technology, London, and was awarded the Ph.D. degree of the London University for his original investigations. He returned to India in 1933 and soon after was appointed a research assistant in the Rust Research Scheme of the Imperial Council of Agricultural Research. He was appointed a member of the teaching staff of the Department of Botany, Calcutta University, in the year 1935. He organised the Department of Mycology and Plant-pathology of the University and initiated research in these subjects. He himself was employed in the study of the fungi causing damage to fruits under storage conditions.



Dr. P. N. Ghatak

Dr. Ghatak was a very successful teacher and was greatly loved by his students and colleagues for his amiable disposition. His death at the early age of 37 is a loss to his wide circle of friends, relatives and to the science of Botany.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A., *University Librarian, Madras*

Smith, William (1769–1839)

WILLIAM SMITH, an English surveyer by profession and father of English stratigraphy by reputation, was born at Churchill, Oxfordshire, a village already famous as the birth-place of Warren Hastings, on the 23rd March 1769, the same year that gave birth to Cuvier, the famous French biologist who also contributed much to the stratigraphy of tertiary formations. Smith lost his father in his eighth year. His education did not take him beyond the village school. With difficulty he procured means to purchase a few books from which he might learn the rudiments of geometry and surveying. He soon came to be interested in drainage and made such progress in his studies that at the age of eighteen he was taken as assistant to a surveyer.

His Career

From 1793 he was the surveyer and resident engineer of the Somersetshire Coal-Canal. His mastery of scientific principles, his success in dealing with difficulties in drainage and all other questions connected with water led to his being summoned to different localities and gave him almost a monopoly of work for drainage and irrigation. Thus he earned a good deal but he spent more than he earned to the cause of his first love—stratigraphy—and this brought him to penury towards the end of his career.

Foundation of English Stratigraphy

Even as a child he had begun to collect stones, particularly of the well-preserved fossils of which the jurassic rocks of his neighbourhood were full. From an early part of his professional career, his attention was arrested by the connection between the soils. His first start on geological exploration work took place in 1794 when he went to north of England as a member of a Committee to explore the route of a canal to be constructed. The constant and close observation which he was compelled to give to the strata that had to be cut through in making the canal, led him to give special attention to the organic remains in them and to perceive that "Each stratum contained organised fossils peculiar to itself, and might, in cases otherwise doubtful, be recognised and discriminated from others like it, but in a different part of the series, by examination of them". In 1799 he circulated in manuscript the order of succession of the strata and the imbedded organic remains found near Bath.

The First Geological Map

Much of his work was inserted upon maps, wherein he traced the position and range of each of the several groups of rocks with which he had become familiar. Data for maps were continuously added and in 1813 the work of engraving the grand final map was begun and it was published in 1815. This was the first geological map of England. It is 8′ 9″ × 6′ 2″ and is now exhibited in the Geological Department of the British Museum (Natural History) near his geological collection.

His Publications

As his general education was meagre, he found it difficult to write. Still under pressure from friends he overcame his reluctance to authorship and published in 1806 his *Observations on the utility, form and management of water meadows.* He also published his *Strata identified by organised fossils* (1816), *A stratigraphical system of organised fossils* (1817) and a reduced edition of his map (1819).

His Honours

In 1831 he received from the Geological Society the Wollaston Medal and Sedgwick, the President of the Society, seized the occasion to proclaim the admiration of all the geologists of England towards the man whom he named "the father of English geology". Next year the Government of William IV granted him a pension of 100 *l* a year, at the instance of the representatives of British science. In 1835 the Trinity College of Dublin conferred on him the honorary degree of LL.D. In 1838 he was employed on the Commission appointed to select the stone for the new houses of parliament.

His End

On his way to Birmingham to attend the meeting of the British Association on a special invitation, he stayed with some friends at Northampton. A cold, of which he had made light, assumed a serious form; and he died August 28, 1839.

Goodale, George Lincoln (1839–1923)

GEORGE LINCOLN GOODALE, an American botanist, was born in Saco, York County. He first studied at Amherst College, where he had been associated with Edward Tuckerman, the foremost American authority on lichens. After a year as assistant in chemistry, he studied medicine and earned the M.D. of Harvard in 1863.

His Career

After a few years of practice, when he published his botanical papers in the reports of the state survey and thereby attracted the attention of Asa Gray, he was called to Harvard in 1872 as instructor in Botany. In this modest position, he developed a lecture method characterised by finish, dignity and clarity and became so popular that the instructorship developed into an assistant professorship and later a professorship which he held till his seventieth year.

His Contributions

To the hitherto almost exclusively taxonomic interest in plants, Goodale added interest in the morphological and physiological questions, which have since so stimulated the study of nature. He was the author of the first physiological botany in America, published in 1885 as Vol. II of *The botanical text-book* of Asa Gray. By extensive travels to the sources of tea, coffee, sugar, rubber and other plant products and the collection of specimens for the Harvard Museum, he also stimulated interest in economic botany.

Goodale died April 12, 1923.

ASTRONOMICAL NOTES

Planets during September 1939.—Mercury will be a morning star for a few days in the beginning of the month and on September 22 will be in superior conjunction with the Sun. Venus will likewise be in conjunction on September 6 and will not be visible during the month. Mars will continue to be a bright object very near the meridian in the early part of the night; it is moving eastwards in the constellation Sagittarius and gradually getting fainter, its stellar magnitude on September 15 being −1·5 (nearly equal to that of Sirius).

Jupiter, which will be in opposition to the Sun on September 28, will be at its brightest magnitude −2·5, and can be seen almost throughout the night. Saturn is moving slowly in a retrograde direction in the constellation Cetus and will be crossing the meridian about a couple of hours after midnight. The ring ellipse is widening, the angular dimensions of the major and minor axes being 44″ and 12″ respectively. Uranus will be found a little to the north-east of Saturn in the eastern border of Aries. A lunar occultation of some interest that can be observed in this country is that of α-Cancri (a fourth magnitude star) on September 11.

Comets.—Periodic comet Brooks II was detected at its return on June 17 by Jaffers and Miss Adams at the Lick Observatory (U.A.I.Circ. 779). The object was exceedingly faint—of the 17th magnitude, and the physical appearance is reported to have been diffuse without central condensation or nucleus. The comet has a period of 6·94 years and is due to pass perihelion on September 15. It is likely to become bright enough to be visible with moderate optical aid. The other comets discovered this year will be very faint and can be seen only with powerful instruments.

Variable Stars.—Two well known variable stars O ceti (Mira) and χ cygni are reaching maxima at the end of August and will probably be visible to the unaided eye in September. The position of the former is given by R.A. $2^h\ 16^m$ Declination 3° 15′ South. The stars are readily identified by reference to a map. The course of their light changes can be deduced by comparing them with surrounding stars.

T. P. B.

International Congress of Anthropological and Ethnological Sciences

A pre-war organisation, known as the Congress of Anthropology and Prehistoric Archæology, was founded in Europe as early as 1865, and its reunions were held at Geneva (1912), Monaco (1906), Paris (1900), Moscow (1892), Paris (1889), Lisbon (1880), Budapest (1876), Stockholm (1874), Brussels (1872), Bologna (1871), Copenhagen (1869), Norwich and London (1868), Paris (1867), Neuchatel (1866), and Spezzia (1865). A projected session of the Congress which was to have met at Madrid in 1916 had unfortunately to be dropped on account of the Great War. After the War the *Association pour l'enseignement des sciences anthropologiques* at Paris established in the same city, under French law, a permanent organisation with the name *Institut international d'anthropologie,* with the object of "grouping, co-ordinating, and centralising the efforts of all persons engaged in anthropological problems, provided they are accepted by its *conseil d'administration*". Till the year 1927 the *Institut* did good service to anthropology, but most foreign anthropologists were not satisfied with its organisation which was international only in name. Attempts to revive the older congress and enlarge the scope of the *Institut* were not successful, but in 1933, on the initiative of Royal Anthropological Institute of London and the survivors of the Geneva committee of 1912, a conference was held at Basel to consider measures for the establishment of a truly international organisation of which the ICAES was the result. Prof. J. L. Myres (Oxford) who represented the Royal Anthropological Institute invited the ICAES to hold its first session in London.

The first session of the Congress which met in the University College, London, was an unqualified success due particularly to the organising capacity of its British General Secretary, Prof. Myres. The Duke of Onslow was the General President, and the session was opened by H. R. H. Prince George acting on behalf of his brother, the Duke of York (now King George VI) the Patron of the Congress. The work of the session was done in eight main sections: Anatomy and Physical Anthropology, Psychology, Demography and Population Problems, Ethnography, Technology, Sociology, Religion, and Language and Writing. Recommendations were adopted in regard to teaching of Anthropology and Ethnology in Schools and Universities; the need for further research into the mental aptitudes of African peoples; the creation of a permanent census of India; and training of administrators in Anthropology, etc. Committees were set up to encourage the use of films in anthropological work, for the standardisation of anthropological technique, for international research on arctic peoples and cultures, and for the compilation of a comparative vocabulary of anthropological and ethnological terms.

The second session of the Congress was held in Copenhagen in August 1938 under the presidentship of Dr. Thomas Thomsen of the Danish National Museum and the patronage of King Christian X of Denmark and Iceland, "who honoured the inaugural meeting with his presence". It was attended by over 700 delegates from all parts of the world. There were additional sections for Asiatic Ethnography, Arctic Ethnography, European Ethnography and Folklore. In addition to the existing committees fresh ones were constituted for the conservation of aboriginal people and to deal with the problems of megalithic cultures.

India is represented on the *Comité d'honneur* by Rai Bahadur Sarat Chandra Roy of Ranchi, and on the Permanent Council by Mr. K. P. Chattopadhyay, Prof. G. S. Ghurye, Dr. B. S. Guha, Mr. J. P. Mills, Dr. A. Aiyappan and Dr. B. K. Chatterji, the last two being National Secretaries for India. The functions of these representatives are "mainly to ensure that the work of the Congress is known to all students of the subjects with which it is concerned; to bring to the notice of the Congress Bureau all projects for collaborated research in which assistance is offered or desired by their compatriots; and to take the necessary measures to ensure that the next session of the Congress (which should be in 1942) is announced to Indian anthropologists and ethnologists, and that suitable communications are made by them". The official language of the Congress is French, but communications are permitted to be in German, Italian, English and Spanish.

A. AIYAPPAN.

SCIENCE NOTES AND NEWS

Study of the Oil from the Seeds of Star-anise (Illicium; Natural order: *Magnoliaceæ*). —Messrs. J. W. Airan and S. V. Shah (Rajaram College, Kolhapur), write:

The physical and chemical constants of the fixed oil (Petrol Ether extract, yield 55 per cent. on the weight of the decorticated seeds) from the seeds of Star-anise, which is reputed to be of medicinal value (Nadkarni, *Indian Materia Medica*, 1927, pp. 463) have been determined. The oil has a reddish yellow colour and does not possess any characteristic taste. The data obtained are summarised in Table I.

TABLE I

Specific Gravity at 25° C.	0·9128
Refractive Index at 25° C.	1·4677
Acid Number	11·62
Saponification value	194; 195
Iodine Value	88; 89
Reichert-Meissl value	0·746; 0·758
Polenske Number	0·28
Acetyl Value	8·41; 8·33
Unsaponifiable matter	0·5676 %

* * *

An Absolute Determination of the Acceleration due to Gravity.—In the *Philosophical Transactions of the Royal Society*, (A), 1939, 238, 65–123, J. S. Clark has given an account of a new determination of the acceleration due to gravity at the National Physical Laboratory, 51° 25′ 14″ N. and 0° 20′ 21″ W., and 10 metres above sea-level. A reversible pendulum of light metal (Y-alloy) of an I-section and one metre in length was swung from a knife-edge in vacuum. Blocks of non-magnetic delta metal were attached to the ends of the I-section rod, two exactly similar blocks B and C being fixed on opposite sides, and two more blocks D and E attached to C at one end. The blocks B and C carry planes which are supported on the knife-edge. The pressure in the tube E inside which the pendulum oscillated was less than 5×10^{-3} mm. Three platinum resistance thermometers were used to obtain the temperatures at three different parts of the pendulum. Electrical signals were produced by means of a platinum contact piece attached to the pendulum; the closing of the contact was made to short-circuit a portion of the grid bias battery of a valve circuit. This relay operated the marker which recorded the oscillations of the pendulum on a chronograph record on which another marker recorded the oscillations of the N.P.L. quartz crystal clock. A special support made of girders was used, and the knife edges were of hardened steel. The effect of the yield of the support was determined according to the method of Schumann (1899) by means of observations on the amplitudes of two pendulums swung from the support. There were 100 divisions to a second on the chronograph record and readings could be taken correct to 0·05 of a division. By observing 12,195 vibrations the half period was found to be $1{\cdot}002891_8$ sec. The length of the pendulum was found by means of a standard end-gauge. The effects of a change of amplitude and the buoyancy, drag and viscous resistance of the residual air were found to be negligibly small. Corrections were made to allow for the changes in the effective length of the pendulum on account of (1) variation of temperature; (2) the reduced pressure (the length was found to have increased in vacuum by 0·6μ); (3) the elasticity of the support (the length increased by 1·5μ); (4) the compression of the knife-edge (the length increased by 0·5μ); (5) the elasticity of the rod (the length diminished by 0·7μ); and (6) the curvature of the knife-edges (the effect on g varied from 0·0001 to 0·001 gal.). The following is the author's estimate of the likely errors on account of the various factors affecting the determination of the periods T_1 and T_2:

Temperature	± 0·6 mgal.
Amplitude	± 0·3 mgal.
Clock Rate	± 0·3 mgal.
Interpretation of Chronograph Record	± 1·1 mgal.
Radius of knife-edges	± 0·1 mgal.
TOTAL	± 1·3 to 1·4 mgal.

The final value obtained for g at the above location was 981·1815 gal. T. S. S.

* * *

Variations in Cosmic Ray Intensity and Cosmic Ray Bursts.—The analysis of cosmic ray intensity measurements carried out on voyages on the Pacific Ocean (Piara S. Gill, *Phy. Rev.*, 1939, 55, 1151) reveals that the minimum of cosmic ray intensity near the equator averages 10·3% less than that at Vancouver (lat. 54°·8). The origin of the latitude effect

can be accounted for in terms of the minimum energy required for primary electrons to produce mesotrons capable of traversing the atmosphere. The observed atmospheric temperature variations (P. S. Gill, *Phy. Rev.*, 1939, 55, 429) support Blackett's theory that it is due to changes in elevation of the mesotron producing layer with the thermal expansion of the atmosphere. The small amplitude of sidereal time variation (A. H. Compton and P. S. Gill, *Phy. Rev.*, 1939, 55, 233A) seems to show that the rays do not come directly from outside our galaxy.

The latitude effect for very large cosmic ray bursts is found to be about 30% (W. P. Jesse and P. S. Gill, *Phy. Rev.*, 1939, 55, 583). This result leads M. S. Vallarta (*Phy. Rev.*, 1939, 55, 583) to suggest that the primary particles responsible for large bursts may carry a multiple of the electronic charge in addition to possessing a large mass. The value of 10^{-4} for the creation probability of a burst by a mesotron of about 2×10^{10} ev. energy in a thickness of 12 cm. of lead (reported by P. S. Gill and M. Schein at the symposium on cosmic rays at the University of Chicago at the end of June of this year) leads to a cross-section per nuclear particle of about 2×10^{-30} cm.^{2} comparable to that estimated by Euler and Heisenberg for nuclear explosions. C. K. S.

* * *

A Contribution to Perkin's Reaction.—Gunther Lock and Erwin Bayer (*Ber.*, 1939, 72, 1064) have added further data on the effect of substituents on the yields of cinnamic acid by Perkin's reaction. Mesityl-aldehyde gave 0·5 per cent. and dinitro-mesityl-aldehyde 60 per cent. yields of the corresponding cinnamic acids prepared under the same conditions. Polynitrobenzaldehydes react so energetically that complete decomposition occurs. The effect of different halogens in the *para*-position which reduces the yield, the effect of molecular weight in homologous derivatives and of the methoxyl group have been determined. The effect of some of these conditions on Knovenagel's method of preparing cinnamic acid have also been studied and the authors conclude that though recently Knovenagel's method is more usually employed for cinnamic acid, Perkin's method generally gives higher yields.

* * *

Addition of Maleic-Acid-Anhydride to Terpene Hydrocarbons.—Diels and Alder, Dupont have already shown that maleic acid anhydride combines easily and rapidly with terpene hydrocarbons having conjugated double bonds as α-terpinine and phellandrenes forming hydrated substituted phthalic acid anhydrides. It was suggested that it can become a standard method of examination. Kurt Hultzch (*Ber.*, 1939, 72, 1173) has however found that terpenes without conjugated double bonds also give crystalline addition compounds when the components in 1:1 proportion are heated. Thus products from limonene, carenes and terpinolene have been carefully prepared and studied. Naves drew attention sometime ago that some primary and secondary alcohols as cyclohexanol, benzyl alcohol react with maleic anhydride.

* * *

The problem of replacing with metal the celluloid used for film negative has at long last been solved (according to the *Deutsche Bergwerkszeitung*, No. 165, July 1939) and a demonstration of the "Metal film" was held at Berlin last month before experts and representatives of the Press.

The metal films shown at the demonstration were of two kinds; an iron strip coated with aluminium, 0·05 mm. thick; and pure aluminium strips of 0·08 mm. thickness. The metal films are thus appreciably thinner than the celluloid films and in the case of the aluminium film actually lighter; the iron film is only slightly heavier weighing about 1 g. more than the celluloid film for every metre length of standard size.

The chief advantages of the metal film are, non-inflammability, freedom from crumpling and creasing of the light-sensitive material often experienced in celluloid films, and the greater reflecting power of the metal surface.

While the new metal films can be projected on the standard "Talkie" equipment with minor adaptations, it is not expected that the celluloid film will be replaced by metal in the near future. But, for time-exposures in microphotography, for educational films subject to frequent handling, and for film archives, the metal film is specially suited. A particular advantage offered for archives is that *both* sides of the film can be used thus economising expense and space.

The metal film was developed by Semenitz under the auspices of *Amt fur Technik*, Berlin. EMMENNAR.

* * *

Fauna of Dal Lake, Kashmir: Leeches.—M. L. Bhatia has reported on a collection of leeches taken in the Dal Lake, Kashmir (*Bull. Dept. Zool. Punjab Univ.*, Vol. II, 1–17) and finds from forms in the collection, one which is a new species of Theromyzon, called *T. mathaii*. The four forms described fall under two families. *Glossiphonia complanata*, *Theromyzon mathaii* and *Hemiclepsis marginata* belong to Glossiphonidæ and *Erpobdella octoculata* belongs to Erpobdellidæ. Detailed descriptions of the four species are given. In addition egg capsules of *Erpobdella octoculata* never before recorded from Indian forms have been described.

* * *

Corpuscles in Blood of Invertebrates.—The variety of cellular elements found in the blood of invertebrates is more abundant than that in vertebrates. But the blood cells of the former are more primitive than those of the latter. Moreover, a transformation of one cell into another is possible in case of adult healthy invertebrates and in many points the hæmolymph cells of invertebrates are similar to the embryonic blood cells of vertebrates. These are some of the conclusions that T. Ohuye (*Sci. Rep. Tohoku. Imp. University*, Dec. 1938, 13, No. 3, 359) draws from an examination of the blood fluid of 44 species of Invertebrates and Protochordates, belonging to

practically all the phyla. He does not find any fundamental difference between the erythrocytes of vertebrates and those of invertebrates. The granular inclusions found in both erythrocytes as well as leucocytes appear to be similar in their chemical reactions and probably the Erythrocytes are modified leucocytes. The lymphocyte (hyaline colourless variety of leucocytes) which is probably the simplest leucocyte, is capable according to the author, of a varied differentiation dependent on environmental factors and is probably the progenitor of all other elements found in the invertebrate body fluid. Granular leucocytes with polymorphic nuclei are however, rare in invertebrates.

* * *

African Palms as Useful Plants.—An exhaustive account of the occurrence, nativity, distribution and economic uses of the more important African Palms has recently appeared (Barret, *Der Tropenpflanzer*, 1939, 42, 185).

As compared with the Indo-Malayan region, Africa is said to be very poor in palms but it is characterised by a number of endemic genera. Of these *Jubœopsis caffra* is very interesting on account of its close affinity to the cocoanut palm. The Oil Palm (*Elaeis guineensis*), is the most important of the African Palms and apart from its oil, is the chief source of toddy for the natives; the fruit flesh is also eaten. The cultivated forms are very widely distributed while the true wild forms are found only in deep inland forests. Cocoanut (*Cocos nucifera*), date (*Phœnix dactylifera*) and palmyra (*Borassus œthiopium*) are other well-known palms found in abundance. The African palmyra differs from the Indian forms in having a prominent swelling at the top portion.

Of the various other palms, *Raffia*, so called on account of the fronds, with its 30 species, forms the richest genus. They are gigantic palms with pinnatifid leaves. The fronds which individually measure about 20 meters are responsible for their gigantic appearance, the stem itself not being particularly high. The well-known *Raffia* bast, obtained from *R. Ruffia*, is employed in making mats, floor carpets, wall screens, curtains, bags, cases for cigars and cigarettes, hats, etc. Very thin fibres are used for making clothes. Large sacks are manufactured for packing coffee and sugar. This palm is very easy to cultivate and is extraordinarily quick growing; in four years the plant attains an astonishing size.

The cabbage palm, apart from its well-known use as an edible delicacy, is also used by the natives for extraction of oil; the palm-wine is obtained from the seeds. The sweet fruits of the flabellate palms, *Hyphœne*, are highly valued by the natives. The *Rattan* is poorly represented in the African forests. The pigmy palm, *Chamœrops humilis* is found wild. Its finely divided petiole gives the export article, *Crin d'Afrique*. The vegetable horse-hair from the petiole, used for stuffing pillows, etc., is immune from the attack of insects.

There are references in this interesting article to many other palms, the numerous uses to which they are put by the African natives, and their industrial possibilities.

The only important work dealing with Indian Palms appeared in 1926 (E. Blatter, *Palms of British India and Ceylon*, Oxford University Press), but this work needs to be brought up to date. It would be a move in the right direction if the Botanical Gardens in India undertake the task of collecting and growing the world palms, in view of their economic importance. N. KRISHNASWAMY.

* * *

The Solubility of Cements.—The solubility of cement is one of the factors affecting the deterioration of dams. An investigation has been carried out at the Building Research Station (*Research Technical Paper* No. 26, 1939, H.M. Stationery Office, London, 6*d*.) on methods for comparing the relative resistance of cements to leaching when soft waters percolate through concrete. The investigation is described in this publication and the results show that a relatively simple test, developed originally in Sweden, is adequate for practical purposes.

* * *

The Detection of the Carbon Bisulphide Vapour.—Leaflet No. 6 in the series issued by the *Department of Scientific and Industrial Research* on methods for the detection of toxic gases in industry deals with carbon bisulphide vapour (published by H.M. Stationery Office, 3*d*. net). The situations where this vapour may occur in dangerous concentrations include works where the following are manufactured:—artificial silk (viscose), chemicals, coal gas, vulcanized and "dipped" rubber goods, and tar distillation products.

In high concentrations it may cause delirium, coma, and death from respiratory failure. The better known effects, however, are those of a severe chronic poisoning of the nervous system with a great variety of symptoms, varying in degree from slight fatigue and giddiness to serious mental derangement, blindness, and paralysis.

It is stated that the permissible concentration of carbon bisulphide vapour in the atmosphere of work-rooms should be kept well below one part in 30,000 of air, and preferably not above one part in 100,000.

The standard method adopted for the detection of low concentrations of carbon bisulphide vapour in industry depends upon its interaction with diethylamine and copper acetate, to produce a coloured compound, copper diethyldithiocarbamate.

A series of standard colours is first made up by the addition of small quantities of the reagents to dilute alcoholic solutions of carbon bisulphide of known strength. Samples of the air under test are then drawn, by means of a handpump of definite capacity, through a bubbler of alcohol containing the reagents, and the mixture allowed to stand. The colour developed is compared with the series of standards, and from the number of pump strokes made and of the colour obtained, the concentration is estimated by reference to a table.

Concentrations down to 1 part in 120,000 can be estimated in this manner with 20 strokes, or less, of the pump.

Any traces of hydrogen sulphide in the atmosphere will also produce a colour with the reagent. These can, however, be removed (if not more than 1 part in 10,000) by drawing the air sample first through a filter-paper impregnated with lead acetate.

Full instructions for carrying out the tests are contained in the leaflet.

* * *

University of California Publications.—One of the recent numbers of the *Bulletins of the Geological Department, University of California* (Vol. 24, No. 8) contains a valuable paper by V. L. Vanderhoof on the Miocene Sirenian *Desmostylus*. After a thorough examination of the fossil remains of this form, the author has shown that this animal is undoubtedly a member of the Sirenia, and that *Cornwallius* must be considered to be ancestral to *Desmostylus*. The stratigraphic range of *Desmostylus* appears to be limited to the upper middle Miocene and lower upper Miocene while *Cornwallius* is confined to upper Oligocene. There is a complete Bibliography at the end, bearing on this subject and the paper is illustrated with numerous photographs and sketches.

Another of the *Bulletins* (Vol. 24, No. 9) is devoted to the study of Mount St. Helens, a recent Cascade Volcano, by Jean Verhoogen. After giving a brief account of the general geology of the region, the author proceeds to record a detailed description of the deposits due to the volcanic activity, including a petrographic account of the lavas and their chemical composition—from which he shows that Mount St. Helens contrasts with the other Cascade volcanoes hitherto described. The paper is well illustrated.

* * *

Scientific Expedition to Central Pacific.—Plans for the most extensive scientific survey yet undertaken of the vast island-studded Central and South Pacific Ocean, with a view to solving by geophysical methods some of the fundamental geological problems of the Pacific, have been announced by Dr. Gilbert Grosvenor, President of the National Geographic Society. The Expedition, which will start in September, will be in the field for a year and will be conducted by the National Geographic Society and the University of Virginia with the co-operation of the United States Coast Guard.

Arrangements for the scientific expedition, which will be made on a Coast Guard Cutter, have been reached in consultation with President Roosevelt, Secretary Hull and Under-Secretary Welles, Secretary Morgenthau and Rear-Admiral Russel R. Waesche, Commandant of the Coast Guard, who are particularly interested in the contributions to navigation, both by water and air, that will be made by the magnetic studies which are a part of the expedition's schedule. Concurrently with the carrying on of the scientific work, the Coast Guard will make a survey of the present and future needs for navigational aids and radio facilities to assist marine and air commerce.

The Expedition will be led by Professor Wilbur A. Nelson, Head of the School of Geology of the University of Virginia; the Expedition's personnel will include geophysicists, a geographer, a cartographer and a photographer provided by the National Geographic Society; experts on gravity from the U.S. Coast and Geodetic Survey; specialists on magnetism from the Department of Terrestrial Magnetism of the Carnegie Institute of Washington; and a naturalist from the Smithsonian Institution who will specialize in marine biology. The National Broadcasting Company will send radio engineers with the Expedition to investigate radio phenomena, and will arrange a number of broadcasts by members of the scientific party from remote islands.

The geophysicists will set up stations on the various islands and from them will make gravity and magnetic determinations. At the same time the geology and structure of the islands will be studied. Although a number of magnetic determinations were made in the area a decade and more ago, no gravity work has been carried on there; and never before has there been an opportunity to tie together magnetic, gravity, and geologic observations in this important region of the Pacific. The simultaneous findings in the three fields will make it possible to reach scientific conclusions that could not be deduced from the same information collected singly in any of the fields. The expedition will set up major bases on twenty or more islands; from each major base from 10 to 50 other islands will be examined.

The Expedition also will be supplied with charts showing the accurately located "epicenters" of earthquakes that have occurred in the Pacific over many years—that is, the locations directly above the points of origin of the earth waves. The scientists will correlate this information with that which their instruments reveal.

The area, 4½ million square miles in extent, which will be covered by the Expedition lies in general south of the Hawaiian Islands, east of Australia and New Guinea and north-east of New Zealand.

* * *

A Windmill Generator for Charging Batteries.—A small windmill-generator for charging a six-volt storage battery is described in *National Research Publication* No. 813. (Copies obtainable from the *National Research Council*, Ottawa, Canada. Price 25 cents.) An automobile-type generator with high-duty armature and standard cut-out, a strong mast, and a windmill blade are the main items in the unit. The first two of these may easily be obtained ready for use.

The blade may be fashioned from a piece of British Columbia spruce, white pine, maple, or yellow birch measuring at least 5′ 6″ × 1′ 6″ × 6″. Detailed instructions for making the blade are supplemented by two charts that should make the job a comparatively easy one.

It is stated in the publication that if the bearings and commutator of the generator are relatively free from friction this unit should begin charging at a wind velocity of eight miles per hour.

* * *

The Indian Lac Research Institute, Ranchi.—The *Annual Report* of the Institute for the financial year 1938–39 constitutes an impressive

record of substantial progress. Fundamental work on lac which is one of our economically important products, has been sadly lacking in this country; it is a matter of extreme gratification to observe that fundamental work on the constitution of lac has now been earnestly taken up under the direction of its present director. In the past, investigations in this field were conducted mostly in the laboratories of Europe and America and we have no doubt that should the same rate of progress be maintained the centre of research in this field will soon shift to Ranchi.

Researches on the modification of lac resins with a view to improve its properties have yielded results of technical interest. Experiments on the extraction of kiri, the dewaxing of shellac, the washing of seed lac and the production of lac-oil varnish, have been fruitful and suggestive. Shellac has been shown to be capable of being modified for rapid moulding and a scheme of co-operative research with bakelite-moulding firms has been inaugurated.

The activities of the Institute have been demonstrated before an assembly of about 80 manufacturers who wish to adopt improved methods of manufacture. This is a fine example of what should be done by other institutions in the country which claim to prosecute industrial research. We wish to warmly congratulate the Director of the Institute on the substantial contributions which he and his colleagues have made to the Indian Lac Industry and we hope that the Indian Lac Cess Committee will secure the continued services of its present Director, under whose auspices the Institute will have an illustrious and useful career.

* * *

Haffkine Institute, Bombay.—The report of the Haffkine Institute for the year 1938 which has just reached us, portrays the activities of the Institute in several useful directions, particularly in the production of prophylactic vaccines and in the diagnostic work for the hospitals. The fulfilment of these two routine but vitally important duties claimed the major portion of the resources of the Institute both in funds and personnel.

Nevertheless, Lt.-Col. S. S. Sokhey, the Director, has been able to maintain and expand the research activities of the Institute; this is largely due to the generous aid of the Indian Research Fund Association which provided both funds and personnel for the prosecution of important lines of investigation. For plague and pharmacological researches, the Association contributed about Rs. 50,000. Two voluntary workers and a Lady Tata Memorial Scholar have participated in the research activities of the Institute.

There has been a long-overdue and welcome addition of a department of medical entomology to the Institute which is to undertake investigations on the rôle of insects in the spread of disease.

During the year the Institute collaborated with the Public Health Department in an enquiry into the outbreak of typhoid in the City of Bombay, which has yielded results of great importance to the public health of the province. The value of such collaborative efforts is undoubted; there are several public health problems which need immediate investigation; but unless the staff of the Institute which is inadequate, is strengthened by a field unit, such problems vitally important as they are, cannot be tackled. It is hoped that there will be more of such collaborative effort in future.

* * *

Agra Central Observatory.—An important change will be effected in the activities of the Agra Observatory with the shifting of the Observatory from Agra to Delhi and the opening of a Forecasting Centre in Delhi decided upon by the Government of India.

The Aerological Observatory at Agra was established in 1914 purely as a research centre.

The rapid development of upper air organisation since 1924 has resulted in considerable expansion of the Observatory's work. The application of upper air wind data to aviation has grown and in such a way as to surround the original functions of the Agra Observatory with an overgrowing mass of other duties particularly of organising and running a large number of pilot balloon observatories in the interests of the ever-increasing need for aviation. The decision of the Government of India to establish a forecasting centre at Delhi has provided a suitable opportunity for the consolidation and expansion of the activities of the upper air observatory. After the shift of the upper air observatory from Agra to Delhi, it will come in closer touch with aviation interests and will have access to upper air charts as used in day-to-day forecasting.

Agra controls a network of 34 stations over India and the Persian Gulf, which let off pilot balloons filled with hydrogen, twice or thrice a day. Information about the direction and velocity of the winds in the upper air, which is of great value for weather forecasting and so important for aviation, is obtained by following the course of these balloons.

The Observatory trains the staff for outstations and supplies balloons, cylinders of compressed hydrogen and all other equipment necessary for their maintenance. The daily observations from the pilot balloon observatories are telegraphed to the various forecasting centres which issue weather forecasts for aircraft, shipping and the general public. The observations taken at the stations along the regular air routes are wirelessed to planes in flight and the aerodromes. At the pilot balloon stations the data collected are scrutinised and computed in various forms suitable for publication for the benefit of the aviation and other interests and of meteorological research.

* * *

Indian Central Cotton Committee.—The half-yearly meeting of the Commitee was held in Bombay on the 3rd and 4th August, Mr. P. M. Kharegat presiding. The Commitee reviewed the annual progress reports and progammes of work of the various schemes financed by it. Among the more important schemes which were provisionally extended are: The Punjab Botanical Scheme (1 year), The Punjab Physiological Scheme (3 years), The Punjab Cotton Jassid Investigation Scheme (3 years), The Bengal Comilla Cotton Scheme (2 years), The

Hyderabad Bollworm Clean-up Scheme (1½ years) and the Surat Seed Distribution and Extension Scheme (3 years). The schemes for the improvement and development of cotton in Cutch State, for co-ordination of research work in black-headed cricket in Sind and Baluchistan, and for the improvement of cotton crop in the Kaira District (North Gujerat) were sanctioned.

The Committee noted that its proposals for the establishment of a pilot plant for the manufacture of chemical cotton at a cost not exceeding Rs. 50,000 had been sanctioned by the Government of India.

The recognition by the *Bureau International Pour La Standardisation Des Fibres Artificielles* of the Technological Laboratory of the Committee as a neutral Testing House for India to test artificial silk yarns was noted.

* * *

Abundance of Hilsa Crop in 1939.—At the ordinary monthly meeting of the *Royal Asiatic Society of Bengal,* held on the 7th August, Dr. S. L. Hora communicated a note relating to his observations on the abundance of Hilsa crop this year. "Sir K. G. Gupta and later writers on the fisheries of Bengal were generally of the opinion that *Hilsa* is becoming scarce and recommended the establishment of hatching stations to introduce artificial propagation for replenishing the rivers of Bengal. Further, it is still fresh in our memory that the *Hilsa* crop was very poor in 1937 and 1938. Its great abundance in 1939, therefore, has come as a pleasant surprise to the fish-eating population of Bengal and consequently this fact has received considerable attention in the public press." In explaining the probable causes for this unexpected increase in the yield of the fishery for this year, Dr. S. L. Hora gave a brief account of the life-history and the periodic rise and fall in the annual yield of the *Hilsa* fishery.

* * *

Syntomosphyrum indicum.—Information is now available regarding the spread of this chalcid which was introduced into Australia in order to check the fruit fly menace (*Curr. Sci.,* 1938, 7, 302).

In the latter half of the year 1935, Mr. W. B. Gurney, B.SC., Entomologist of the Department of Agriculture, Sydney, New South Wales, visited India and for some months carried out investigations to recover parasites of fruit flies which might possibly be of value if introduced into New South Wales to attack fruit fly there. Several species of wasp parasites of the genus *Opius* (*Braconidæ*) were developed and batches of parasitised Indian fruit fly pupæ were despatched to Australia. Some adults of these Braconid wasps developed on arrival in Sydney, but failed to oviposit and develop in the laboratory in local fruit fly maggots (*Chætodacus*) in fruit presented to them.

In November, 1935, batches of living adult parasitised chalcid wasps (*Syntomosphyrum indicum*) developed from Indian fruit flies (*Chætodacus*), were sent to Sydney, N.S.W., by air mail. Unfortunately, they arrived at a time when no fruit fly maggots were obtainable to expose to these living parasites, and they died out without progeny. However, Mr. Gurney arranged for the Government Entomologists at Bangalore and also at Coimbatore to forward further batches, if obtainable.

In October, 1937, through the courtesy of the Entomologist at Bangalore, a batch of fruit fly pupæ was sent from Bangalore. From these a few of the chalcid wasp parasite *Syntomosphyrum indicum* were hatched in the quarantine insectary of the Department of Agriculture, Sydney. The Entomological Branch here was able to obtain numerous fruit fly maggots and developed increasing numbers of this introduced parasite in the Insectary until, over a period of 5 months, *viz.*, December 1937 to April 1938 some 260,000 living specimens of this introduced parasite were developed and liberated in New South Wales and Queensland and Fiji.

Since that date the aim has been to endeavour to recover in the field living specimens of this parasite during the summer season, *viz.*, from October 1938 till May 1939. So far, however, not a single parasite has been recovered to indicate that this parasite has become established here. Fruit fly maggots and pupæ will be collected throughout the next summer season 1939–40, in a further endeavour to prove whether even a few of the parasites succeeded in surviving in certain of the warmer districts of New South Wales or Queensland. It was always felt that, as these are tropical parasites they might be unable to face the winter conditions of N.S.W., but there was more hope that they might succeed in establishing themselves in the northern sub-tropical areas of N.S.W., or in the tropical parts of Queensland. Fiji also having a tropical climate, the parasite may succeed in establishing itself there.

It will be seen, therefore, that though a very successful development of this parasite was made in the laboratory, and a very big field liberation made, yet, until actual recoveries are made in the field, no claim whatever for success in establishing this parasite or in estimating any results of its presence can be made.

* * *

The Syndicate of the University of Bombay have awarded the **Moos Gold Medal** for the year 1938–39 to Dr. N. C. Chatterjee, Entomologist at the Forest Research Institute and College, Dehra Dun, for his D.Sc. thesis in Zoology. Dr. Chatterjee took the A.I.I.Sc. diploma in 1935 and D.Sc. in 1938. He is a graduate of the Allahabad University and is the first candidate to achieve this distinction in Zoology from the Bombay University.

* * *

Lucknow University.—Messrs. A. Ramachandra Rao and K. Jacob who have been working under Prof. B. Sahni, F.R.S., have submitted their theses which have been approved by the examiners for the D.Sc. Degree of the Lucknow University. The work of these two authors has been warmly commended by the examiners.

Mr. A. Ramachandra Rao's thesis comprised several papers (some published and others unpublished) on the Jurassic Flora of India. (1) The anatomy and affinities of *Taeniopteris spatulata* McClelland. (2) Two petrified strobili from the Rajmahal Hills, Behar. (3) Notes on the anatomy of some silicified ferns from the Cretaceous of Germany. (4) On a collection of

Jurassic plants from the Rajmahal Hills, Behar. (Jointly with Prof. B. Sahni.) (5) *Rajmahalia paradoxa* gen. et sp. nov., and other Jurassic plants from the Rajmahal Hills. (Jointly with Prof. B. Sahni.) (6) Further observations on *Rajmahalia paradoxa*. (Jointly with Prof. B. Sahni.)

Mr. Jacob's thesis comprised five papers (two published and three unpublished) nearly all of them dealing with the Jurassic Flora of India and Ceylon. The full titles of the papers are as follows: (1) Fossil plants from Sakrigalighat in the Rajmahal Hills. (2) On the structure and affinities of *Tinpaharia*, a new Genus of petrified ferns from the Rajmahal Hills. (3) Jurassic Plants from Tabbowa. (4) On *Protocyathea rajmahalense* sp. nov., A Cyatheaceous Tree-fern, with notes on the geological distribution of the Cyatheaceæ. (5) Fossil Algæ from Waziristan.

* * *

Dr. Wilbur A. Sawyer, Director of the International Health Division at the Rockefeller Foundation, has been awarded the Leon Bernard Foundation Prize by the Health Committee of the League of Nations at its meeting held on May 1, 1939. The Committee "wished to pay a tribute to the valuable work done by Dr. Sawyer in combating yellow fever, and in the sphere of medico-social protection, which has benefited the populations of a large number of countries".

The prize consists of a Bronze Medal bearing the effigy of Leon Bernard and a sum of 1,000 Swiss francs. This is the first award made by the Foundation.

* * *

The Growth, Properties, and Structures of Wood.—The inherent variability of timber is an important obstacle to its most effective utilization. A recent report (*Forest Products Research Special Report No. 5*, 1939, H.M. Stationery Office, London, 9*d*.) reviews the present position of knowledge of the anatomical structure of wood, and of the physico-chemical composition of the cell walls, in relation to growth conditions on the one hand and physical and mechanical properties on the other, summarizing the conclusions reached during recent investigations carried out at the Forest Products Research Laboratory. The relative importance of the features determining the properties of wood is discussed from a practical standpoint, and indications are given of the influence of growth conditions on the physico-chemical composition of the wood substance.

* * *

At a meeting of its executive committee held on Friday, the 18th August 1939, the **Association of Technologists, Bangalore,** formed *three* sub-committees: (1) to complete a list of Scientific Instruments and apparatus available in the various laboratories and other institutions in Bangalore; (2) to draw up a list of Scientific Journals and periodicals available in the various libraries and institutions in Bangalore; and (3) to report on the design and construction of laboratories specially suitable for Indian conditions.

* * *

The Finch Electron Diffraction Camera.—The technique of the study of surface structure of single crystals and polycrystalline specimens by electron diffraction methods has reached a high degree of perfection, thanks to the work of Professor Finch and his collaborators. The electron diffraction camera often yields far-reaching results which cannot be envisaged either by microscopic study or by X-ray diffraction methods. The microscope reveals only the coarse structure of the surface of a specimen; X-rays on the other hand give us information about the internal structure of a specimen; but an electron beam, of the same wave-length as the X-rays usually employed, has extremely low penetrating power so that it can be used for the study of the fine structure of surfaces. The three methods, *viz.*, microscopy, X-ray diffraction and electron diffraction, used in conjunction should, therefore, yield all available information about the internal and surface structures of any specimen. While microscopes and X-ray equipments for such work are readily available on the market it is comparatively more difficult to get an electron diffraction camera incorporating all the refinements such as those introduced by Professor Finch. **Messrs. W. Edwards & Co.,** are to be congratulated in having supplied this long-felt need. Their electron diffraction camera, of the Finch type, illustrated in their special folder, is a well-designed complete unit. One can foresee a time when this apparatus will be as common as a microscope in research and technical laboratories.

S. R. S.

* * *

Announcements :

Imperial Dairy Institute, Bangalore.—Students will be admitted this year for the Indian Dairy Diploma course. The course commences in November and is of 2 years' duration. The course includes technical and practical training in dairy and animal husbandry subjects, management of dairy farms, co-operative milk unions, etc.

The Institute also arranges for a post-graduate course (15 months) for agricultural and veterinary graduates and for officers working in the allied Government departments who are desirous of obtaining post-graduate and advanced research experience in animal husbandry.

A well-equipped bacteriological and chemical laboratory is attached to the Institute.

National Centre for Distribution of Biological Products.—The *Biochemical Standardization Laboratory*, All-India Institute of Hygiene and Public Health, Calcutta, has been constituted a 'National Centre' for the distribution of standard preparations of biological products to those who ask for them. If laboratories intimate their requirements, the Centre will import and supply the appropriate standards.

Standards have been established for many products by the Biological Standardization Committee of the League of Nations, and the actual "standard preparation" of each kind is maintained and issued to research and manufacturing laboratories by specified Institutes, such as the

National Institute for Medical Research, Hampstead (under the Medical Research Council) and the State Serum Institute, Copenhagen. For convenience of distribution of the "standards" to those that require them, it has been found advisable to form "National Centres" in countries where biological products are manufactured. These centres receive duplicates of each standard at intervals and issue them to working laboratories for the control of their preparations.

The following are the standards which will be available at the Laboratory:—

Insulin;
Pituitary (Posterior lobe) Standard Powder;
Oestrus-producing Hormones (i) Hydroxy-Ketonic form, (ii) Mono-benzoate of Di-hydroxy form;
Male Hormone (Androsterone);
Corpus Luteum Hormone (Progesterone);
Neoarsphenamine;
Sulphersphenamine;
Ouabain or Strophanthin;
British Standard Tinct. Strophanthus;
Standard Digitalis Powder;
Adrenaline and Scillaren Standards; and also
Chorionic Gonadotrophin (from pregnancy urine).

Messrs. **The Cambridge University Press**, London, announce that the following are among their forthcoming publications. Sir Arthur Eddington: *The Philosophy of Physical Science*; Prof. R. A. Millikan: *Cosmic Rays;* Dr. A. S. Eve: *Lord Rutherford*; Prof. August Krogh: *Osmotic Regulation in Aquatic Animals.*

Forestry Abstracts.—The Imperial Forestry Bureau issues a quarterly journal entitled *Forestry Abstracts.* This will provide a survey in English of the current literature of forestry from all parts of the world. Each issue will normally include special reviews of the literature of particular subjects, notes on annual reports, and abstracts classified by subject. In the abstracts the aim is to epitomize the contents of each paper so as to enable the reader to judge of its value as a contribution to knowledge. In addition to papers in English, French and German, attention will be directed to those published in the less familiar languages.

The first number appeared in June 1939. *Forestry Abstracts* will appear quarterly in September, December, March and June, four numbers constituting a volume. Indexes will be provided annually.

The annual subscription will be:—For residents of the countries of the British Commonwealth and the Anglo-Egyptian Sudan who send their subscriptions direct to the Bureau, 20*sh.* and for all other subscribers, 25*sh.*

* * *

We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, Nos. 10–11.

"Agricultural Gazette of New South Wales," Vol. 50, No. 7.

"The Philippine Agriculturist," Vol. 28, No. 2.

"Indian Journal of Agricultural Science," Vol. 9, Pt. 3.

"L'Agricultura Coloniale," Vol. 33, Nos. 2–3 and 6.

"Allahabad Farmer," Vol. 13, No. 3.

"Biochemical Journal," Vol. 33, No. 6.

"Berichte der deutschen chemischen gesellschaft," Vol. 72, No. 7.

"Contributions from the Boyce Thompson Institute," Vol. 10, No. 3.

"Journal of Chemical Physics," Vol. 7, No. 7.

"Chemical Age," Vol. 41, Nos. 1045–1047.

"Journal de chimie physique," Vol. 36, Nos. 4–5.

"Russian Journal of General Chemistry," Vol. 9, Nos. 4–9.

"Chemical Products," Vol. 2, No. 3.

"Comptes Rendus," (DOKLADY), Vol. 23, Nos. 1–7.

"Experiment Station Record," Vol. 80, No. 6 and Index to Vol. 79.

"Indian Forester," Vol. 65, No. 8.

"Forschungen und Fortschritte," Vol. 15, Nos. 19–21.

"Transactions of the Faraday Society," Vol. 35, No. 219.

"Genetics," Vol. 24, Nos. 3–4.

"Bulletin of the Health Organisation (League of Nations)," Vol. 8, Nos. 1–2.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 2.

"Review of Applied Mycology," Vol. 18, No. 6.

"Calcutta Medical Journal," Vol. 36, No. 1.

"The Mathematics Student," Vol. 6, No. 4.

"Bulletin of the American Meteorological Society," Vol. 20, No. 5.

"Indian Medical Gazette," Vol. 74, No. 7.

"Indian Journal of Medical Research," Vol. 27, No. 1.

"Nature," Vol. 143, No. 3634; Vol. 144, Nos. 3635–3638 and Index to Vol. 143.

"Journal of Nutrition," Vol. 18, No. 1.

"Canadian Journal of Research," Vol. 17, No. 5.

"Journal of Research (National Bureau of Standards)," Vol. 22, Nos. 1–2.

"Sky," Vol. 3, No. 9.

"Science Progress," Vol. 34, No. 133.

"Indian Trade Journal," Vol. 134, Nos. 1725–1729.

Catalogues:

"Scientific and Technical Books, June 1939" (Edward Arnold & Co). "The Cambridge Bulletin," No. 84 (Summer 1939).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

July 1939. SECTION A.—N. V. SUBBA RAO AND T. R. SESHADRI: *Use of Mercuric Acetate in organic preparations—Part I. Mercury compounds of Amides and Imides.* S. RANGASWAMI AND T. R. SESHADRI: *3-Benzoyl-7-Hydroxyflavone.* M. SALARUDDIN AND C. K. ANANTHASUBRAHMANYAM: *The Bright Solar Eruption of March* 3, 1939.—One of the brightest and largest eruption observed in Kodaikanal during the last two years is described. S. S. PILLAI: *On Normal Numbers.* V. S. VRKLJAN: *Ein Versuch der Erweiterung des Krishnanschen Reziprozitatsgesetzes für Schiefe Beobachtungsebe nen.*—Krishnan's reciprocity relation is extended to inclined planes of observation. N. V. RANGASWAMY IYENGAR AND BASRUR SANJIVA RAU: *Interfacial tension studies on Mercury in reacting systems.*—Measurements have been made in systems containing H_2S and SO_2 in CCl_4, sulphur in CCl_4, $KHgI_2$ in water, and $KHg(CN)_2$ in water. D. N. MOGHE: *On a simple system of charged particles in Milne's kinematical theory.* G. S. KASBEKAR AND A. R. NORMAND: *Reaction between Nitric Acid and Tin in presence of Catalysts—Part II.*—Iodides of sodium and potassium retard the reaction. D. N. MOGHE: *On the Stability of Motion in Milne's kinematical system.* S. S. BHATNAGAR, P. L. KAPUR AND G. MITTAL: *Magnetic Properties of Copper Amalgams.*—Amalgams have been prepared under definite conditions by different methods and examined. The observation that copper becomes paramagnetic in dilute amalgams is attributed to formation of paramagnetic oxides during prolonged electrolysis. S. DUTT AND IONE N. D. DASS: *Colour in relation to chemical constitution of the Organic and Inorganic Salts of Isonitroso-Pyrazolones and Isooxazolones.*

July 1939. SECTION B.—T. S. SADASIVAN: *A study of the Growth Reactions of non-parasitic Fungi in Associated Culture.*—The first of a series dealing with the growth reactions, primarily of two non-parasitic fungi, *Fusarium* and *Dendryphiella* in associated cultures. B. N. SINGH AND J. R. SINGH: *Effectiveness of chemical fertilisers on the growth and water requirement of wheat.*—The application of fertilisers, besides showing a higher yield of the crop, has the added advantage of minimising the cost of irrigation. L. S. RAMASWAMI: *Some aspects of the anatomy of anura (Amphibia)*—A Review. C. V. GANAPATHY AND B. N. SASTRI: *Oxidation of Thiols and Ascorbic Acid in the Latex of Papaya.*—Thermolabile systems responsible for maintaining thiols in the reduced condition are present in the latex and pulp-juice of the Papaya fruit. K. S. SRINIVASAN: *On the developmental morphology of androgynous receptacles in* Marchantia palmata *Nees.* G. W. CHIPLONKER: *Bryozoa from the Bagh Beds.*—A detailed study of the Bryozoa obtained, in the main, from the Upper Coralline Limestone, the uppermost member of the Bagh Beds, shows that no species are identical with or even allied to any of the forms described from South India. The Bryozoan fauna can be assigned to a horizon at about the Cenomanian.

Indian Association for the Cultivation of Science (*Proceedings*)

April 1939.—A. C. BANERJI AND NIZAMUDDIN: *Jupiter's Atmosphere.* P. L. KAPUR: *A Note on the Transmutation Function for Deuterons.* S. R. DAS AND K. GHOSH: *A Study of Sulphur Allotropes by the X-ray Diffraction Method—Part II.* S. K. MITRA AND A. K. BANERJEE: *The Light Theory of Aurora and Magnetic Disturbance.*

June 1939.—A. K. SEN GUPTA: *Band spectrum of antimony monoxide.* B. M. ANAND AND S. NARAIN: *On the Raman effect in camphor.* A. K. DUTTA, M. K. CHAKRAVARTY AND S. R. KHASTGIR: *An experimental study of parabolic wire reflectors on a wave-length of about 3 metres.* P. C. MUKHERJI: *On the absorption and emission spectra of rare earth crystals.* J. A. N. THAES: *Measurement by means of the electrometer triode.* M. V. SIVARAMAKRISHNAN: *An improved form of vacuum arc mercury still for laboratories.* S. K. MUKERJI AND S. ABDUL AZIZ: *On the Raman spectrum of* o-*Diphenylbenzene.* D. M. BOSE AND P. C. MUKHERJI: *On the colour of paramagnetic ions in solution, II.—Fine structure of the absorption bands.*

Meteorological Office Colloquium, Poona:

July 15, 1939.—PROF. K. S. KRISHNAN: *The Paramagnetism of Crystals.*

Botanical Society of Bengal:

July 28, 1939.—S. HEDAYETULLAH AND A. K. CHAKRAVORTY: *A comparative study of the construction of mechanical system in the five species of the genus oriza preliminary to the study of lodging of rice plants.*

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Archæology in India

THE report on the work of the Archæological Survey of India, recently drawn up by Sir Leonard Woolley at the request of the Central Government, should prove extremely helpful to the advancement of knowledge of India's past history. It is short and easily read, and deserves to be widely understood, for it suggests ways in which, at an extra cost so small as to be negligible compared with present normal cost, the country could benefit from archæological work to a far greater extent than it has done hitherto.

It points out that "Archæology could and should play a far more important part than it does in the life of the Indian people. In a country where the historical sense has been but little developed, where historical knowledge is very limited and is then confined for the most part to that political history in which the bias of party feeling tends rather to the perpetuation of old animosities than to the consciousness of national unity, the study of the growth of civilisation is the most salutory of all studies. Especially for an Indian at the present time is it important that he should learn how the India which he knows has come into being, understand what is in the light of what has been, and in the clashes of race and creed should stress not the accidents of strife but the power of the Indian spirit to assimilate what was good, even in an enemy culture, without sacrificing its own individuality. Here archæology can help and the Archæological Survey as the official organ of archæology has a duty to perform." This is the point of view from which the whole report has been prepared.

To achieve such ends far more attention needs to be paid to the interpretation of archæological remains than is the case at present, a coherent plan of campaign for

filling the largest and most serious of the many gaps in Indian archæological history should have precedence over continuance of work on sites already comparatively well known, and publication of results needs to be so reorganised as to bring the Department into closer touch with the general public. These and the provision of adequate training are the fundamental recommendations made, but they all involve considerable modification of present practice, and the modifications needed are carefully considered.

The report pleads especially that fair opportunities be given to members of the staff, and points out that this will necessitate specialisation within the Department, for its work "comprises the conservation of ancient monuments, which requires historical knowledge, architectural appreciation and good taste; excavation and exploration, which demand specialised knowledge of a high order such as can be obtained only by years of experience and very careful tuition, to say nothing of such technical equipment as drawing, surveying, photography, etc.; museum work, which is again a life-work in itself. Every member of the staff is expected to be proficient in the work of conservation and excavation, may at any time be put in charge of a museum, and is in addition saddled with a mass of clerical and office work for which he has no special qualifications. In short, each member is expected to be a super-man, and that by the light of nature, for he receives little or no tuition in any of those branches. It should be obvious that with so many diverse calls upon him no man can adequately answer to any of them." "There is in the present staff admirable material, and vacancies in the staff can be filled from the ranks of Indian scholars and individuals of genuine promise; but they must be given a fair opportunity. I have made the acquaintance of nearly all the officers in the service and am convinced that they would be the first to welcome a definition of function and an education that would equip them for the work which they are most anxious to do, just as I believe they would be the first to appreciate the point of the criticisms I have been compelled to make, criticisms which in many cases echo their expressed opinions." "Training and tuition are essential. Unwillingly but inevitably I have been forced to the conclusion that this cannot be got in and from the Department as at present constituted. In the matter of the conservation of standing monuments the Department, following carefully the precedents laid down in the past, has done and is doing admirable work to which I can give unstinted praise; only where the preservation of excavated buildings is concerned, for which the precedents are more doubtful, have they indulged in an exaggerated policy which is wasteful financially and its results scientifically deplorable. In the matter of excavation I have on most sites which I have visited found that the methods employed were bad, trained observation conspicuous by its absence, and the results in consequence incomplete and untrustworthy. In the matter of museum direction the report of Messrs. Markham and Hargreaves is sufficient condemnation; the work is amateurish throughout and is seldom informed by any idea of the purposes which a museum should serve. If the present efforts of the Department can be so characterised it is manifest that the staff, before it can train others, must itself be trained; I therefore recommend the employment of a temporary Adviser on Archæology who could deal with all the points at issue." In Sir Leonard's opinion such an adviser could in five years give the Department all the special training it needs to enable it properly to fulfil its obligations to the country and to train future entrants itself. Such a super-man will on his own showing not be easy to find, and he is careful to indicate how he should be selected (p. 34). The grounds for his admiration of the

conservation of standing monuments by the Department and of his criticisms of their excavation work, conservation of excavated buildings, and management of museums are set forth on pp. 21–32.

On pp. 4–7 the most promising sites for immediate excavation are discussed, and it is pointed out in conclusion that before sites can be selected with really adequate knowledge "there is an enormous amount of preliminary work to be done. Assisted by Circle Officers the archæological staff should from now on be busied in preparing an archæological survey of the whole country. Sites of every kind should be visited, listed, mapped, and a carefully made selection of potsherds, coins, etc., collected from each should be filed for identification when the results of excavation make identification possible. I have ventured to recommend sites for excavation on the strength of the study of gazetteers, archæological reports and such personal investigation as I have been able to make in the course of three months; but the Director-General ought to have at his disposal a detailed survey which would enable him to draw up a programme for future work calculated most surely and most economically to answer to the varying demands of advancing knowledge. Virtually nothing has yet been done in this direction. The task is one requiring organisation and will not yield immediate results, for until the collections of pottery, etc., can be assigned to their place in the type-sequence which only excavation can establish, the sites must remain undated; but the material will be there and the filed information will be of permanent value; but it is one which cannot be taken in hand too soon." The establishment of a pottery sequence—or it may be several such sequences for different parts of the country—is considered to be probably the most immediate need, for without it the dating of sites and of the various strata they reveal will in most cases remain impossible.

Another line that needs to be taken up at once is the investigation of Stone Age remains. "India is one of the richest countries in the world for remains of the earliest phases of man's existence. .... The efforts of keen amateurs such as Foote only emphasised the importance of the problems to be solved; recently a foreign mission has done some pioneer work in the North-West; but it is not too much to say that this rich field has been entirely overlooked by the Archæological Survey of India and remains unknown to science. The neglect of it by the Archæological Survey is due to the fact that the study of Stone Age antiquities is highly specialised and lies quite outside the scope of the ordinary archæologist; it requires a particular type of training, geological knowledge, etc., and no member of the Survey's staff is at all capable of dealing with it. For this very necessary branch of work to be undertaken specialists must be engaged, and so vast is the field that such should form a permanent element of the staff."

If anything like adequate attention is to be paid to the almost unlimited number of sites that seem likely to repay excavation the Archæological Survey, even if much more liberally financed than at present, will need all the outside help it can get. It should co-operate with universities and museums, and do all in its power to attract expeditions from outside the country. But in doing so it must insist that nothing is excavated except directly under fully qualified expert supervision, and that the country's interests are adequately safeguarded in the matter of the removal of antiquities. In regard to the latter, evidence is given of the need for tightening up existing practice in certain respects and for a much greater generosity in others, and amendments to the Ancient Monuments Preservation Act are suggested both in regard to these matters and to private ownership of and trading in antiquities (pp. 9–16). The

most interesting and important objects should only be preserved on the site when, as at Sarnath near Benares, this is easily accessible from some important centre of population, never when it is inaccessible as at Nagarjunakonda. And it should be the aim of the Department to see that the various types of sculpture that have developed at various times in various parts of the country are well represented in museums, both in India and abroad, provided they will be safely preserved and properly utilised for public education. Only first class specimens can worthily represent India's achievements, and in their absence from foreign museums the country will not get a reasonable chance of receiving the appreciation it deserves.

After discussing in detail the departmental changes recommended, and their financial implications, the report concludes "At present the country expends twelve and a half lakhs and gets, in my opinion, very poor value for its money; there is indeed no justification for so great an expenditure unless there is to be a very great improvement in the work done by the Department, and there is no chance of such improvement unless the Department be radically reformed. But given reforms on the lines I have suggested, and this small extra expenditure which they involve, India will in a short space of time be in possession of a first class archæological service which will amply repay its cost. The material for such a service is ready to hand and it only requires to be trained and organised to be of the utmost value both to international science and to the cause of popular education in this country. If on the other hand it be decided that a country so poor as India cannot afford the extra half lakh of rupees which the scheme of reform demands, then I can only say that it is not justified in spending, as at present, some twelve lakhs for which it gets so inadequate a return. It would be better to set aside roughly six lakhs for continuing the upkeep of the ancient monuments already conserved and to close down the Department of Antiquities until the finances of the country were in a more prosperous state or until criticism in India and abroad made the resuscitation of the Department unavoidable."

The report contains valuable suggestions some of which—such as wider co-operation with other institutions—had already been initiated by the present Director-General before it was written. It is to be hoped that its strong wording will not be allowed to interfere with the careful consideration that it obviously deserves, and that the Central Government will not fail to provide the funds necessary to initiate all such developments as this consideration may show to be desirable. India is so large a country that it is impossible to stop or even adequately check the destruction now going on of scattered megalithic antiquities, sculptures, etc. (most of them still unknown to investigators) by road menders, builders, amateur excavators, etc. And if the other alternative is adopted and all but the conservation side of the Department closed down for a time, much of the priceless evidence now available will inevitably have disappeared before it can be investigated and recorded.

The Indian Journal of Entomology

WE have much pleasure in welcoming the entry of a new Indian Scientific Periodical—*The Indian Journal of Entomology*—into the arena of Indian Scientific Journalism. It is intended to be the organ of the Entomological Society of India, which was inaugurated in January 1938 at Calcutta, at a joint meeting of Indian and British Entomologists on the occasion of the Jubilee Session of the Indian Science Congress. Although entomological work has been in progress in India for over fifty years, it is a rather strange circumstance that there has

been till now no Indian periodical entirely devoted to entomological science. Papers on general entomology were being published either in the *Records of the Indian Museum*, the *Journal of the Bombay Natural History Society* or the *Journal of the Royal Asiatic Society of Bengal*, or in foreign periodicals, especially in the United Kingdom. Results of work done on applied entomology, on the other hand, found entry generally into the publications of the Agricultural, Forest or Medical Departments. As only finished work could be accepted in these journals, there has been till now no scope for the record of occasional observations or stray notes by amateur entomologists or beginners in entomology. *The Indian Journal of Entomology* has been designed to meet a long-felt want of entomological workers in India. Whatever the line of work they are engaged in, whether they be systematists or morphologists, whether they be amateur collectors or applied workers on agricultural, medical, veterinary or forest problems, the Journal will be equally open to them for purposes of publication. The Entomological Society of India has established branches at important centres in different parts of India, wherein local members could meet periodically, read and discuss and exhibit any interesting finds.

We may congratulate the editorial staff of the Journal on the excellent get-up of its first number (Parts 1 and 2), which was received sometime ago. It includes, besides the Introduction, the congratulatory messages received from foreign entomologists, an interesting "Retrospect of Entomology in India", and several articles of high scientific value. There are, besides, various interesting notes in connection with the exhibits and communications made at the Branch Meetings of the Entomological Society of India. Reviews of recent research work and of books and monographs offer items of great value to workers—especially such as are beyond the reach of good scientific libraries. "News and Announcements" provide a very welcome fare for the entomological readers, full of human interest. We wish the new Journal a long and successful career.

Cosmic Ray Symposium at the University of Chicago

By P. S. Gill

(*University of Chicago, U.S.A.*)

DURING the last week of June, there was held at the University of Chicago a notable Symposium on Cosmic Rays under the Chairmanship of Professor Arthur H. Compton. Among the leading workers on cosmic rays who took part in the discussions were Professors V. F. Hess, Fordham University; Carl D. Anderson, California Institute of Technology; W. Heisenberg, Leipzig; W. Bethe, Heidelberg; J. Clay, Amsterdam; M. S. Vallarta, Massachusetts Institute of Technology; and Bruno Rossi, formerly of Padua.

Since the early balloon experiments of Hess in Austria in 1912, by which he established the existence of the rays, the study of cosmic rays has contributed much to the fundamentals of physics. Carl D. Anderson discovered positive electrons among his cosmic rays and found evidence for the presence also of the new sub-atomic particle, the meson. Cosmic rays provide a very effective tool for studying the components of atoms and how their nuclei are put together. The discussions were followed with seriousness and interest.

Among the major findings reported may be mentioned conclusive evidence for the existence of mesons, new data with regard to their remarkable penetration, evidence that

they can be formed as rays in the atmosphere by the impact of energetic particles with atoms, and apparently also of their spontaneous disintegration by a kind of radioactive process. Neutrons are much more abundant in cosmic rays than had previously been suspected. It now seems probable that the incoming cosmic rays consist partly of protons, and that these come from our own galaxy.

Studies on the intensity of cosmic rays on the Pacific Ocean reported by A. H. Compton and P. S. Gill reveal that the atmospheric temperature coefficient of cosmic ray intensity is a function of latitude, having a lower value at lower latitudes, a result predicted both by Blackett from his theory of disintegration of mesons and by an alternative method by Vallarta and Godart. M. S. Vallarta and O. Godart of the Massachusetts Institute of Technology discussed their theory of world-wide periodic variations of the intensity of cosmic radiation, based on the interaction of sun's magnetic field with the magnetic field of the earth. Cosmic ray intensity measurements carried out in unmanned balloons at high altitudes by Millikan and Neher at Omaha and W. P. Jesse at Chicago indicate that the intensity is less in summer than in winter.

Investigations carried out by C. D. Anderson and Seth Neddermeyer using a vertical cloud chamber in a strong magnetic field show that the energy loss of shower particles in heavy materials is in accordance with the Bethe-Heitler theory. The experiments reveal further the existence of particles which are more penetrating than electrons but whose specific ionization is not as much as is to be expected if they were protons. P. Auger's experiments at Paris show that electrons and photons often occur in widely spread showers sometimes as far as a thousand feet apart, all appearing to originate from the same parent ray high in the atmosphere. The energy of the original ray which gives rise to such a shower of photons and electrons must sometimes be greater than a million billion electron volts. Dr. S. Korff of the Bartol Research Foundation described a series of his high altitude balloon flights in which associated with these photons and electrons he found the existence of a large number of neutrons. The rate of increase of neutrons is even more rapid with altitude than is the increase in the main body of cosmic rays. It appears possible that the neutrons result from the disintegration of the nuclei of nitrogen atoms when struck by the primary cosmic rays that come from outside the atmosphere. T. H. Johnson also adduces arguments to show that the primaries of the hard component are presumably protons or another type of heavy nuclear particle. A discussion of the mechanism of the production of mesons, however, by W. Heisenberg of Leipzig, indicated that very probably protons should be more important in affecting atomic nuclei than should any of the lighter types of particles. Studies of energy distribution of bursts made by P. S. Gill and M. Schein of Chicago pointed out that at sea level under 12 cm. of lead, the large bursts are produced by mesons because of the similarity of the energy spectrum of a burst-producing radiation to that of the energy spectrum of cosmic rays at great depths as measured by V. C. Wilson of Chicago. They also calculated the cross-section of 2×10^{-30} cm.^{2} per nuclear particle (proton or neutron). The latter value is comparable to that estimated by Heisenberg in his theory of nuclear explosions.

V. C. Wilson of the University of Chicago reported measurements of cosmic rays made in various underground locations, which revealed the existence of the penetrating meson at least to a depth of 400 feet. On the basis of his own new experiments at great depths, J. Clay of Amsterdam suggested that below 400 feet the predominant form of radiation may be protons. Whether this view is correct remains to be answered by further experiments.

The Symposium has not only brought together the leading workers in the field of cosmic rays but the discussions have given many new ideas for further investigation. The generosity and the hospitality of the Chairman, Professor A. H. Compton, added greatly to the success of the Symposium.

Magnetostriction

By D. S. SubbaRamaiya
(*Department of Physics, Central College, University of Mysore*)

THE term *"Magnetostriction"* is applied to denote that class of phenomena in which changes in the state of magnetisation of a body are accompanied by changes in its physical dimensions or form and conversely, mechanical deformations of the body are accompanied by changes in its state of magnetisation. A number of such effects all closely related have been reported. Although these phenomena have been known for a very long time, they were, until recently, only of academic interest. During the last ten years, however, increasing attention has been devoted to the subject and considerable progress has been made. The subject has now acquired a theoretical importance on account of its intimate connection with the theory of magnetism and a practical significance through applications such as the magnetostriction oscillator.

Mechanical Deformations due to Changes in Magnetisation

It was first discovered by Joule in 1842 that a ferromagnetic rod, when placed in a magnetic field with its length parallel to the lines of force, alters in length when the strength of the field is changed. This phenomenon is known as *"The Joule Effect"*. The actual change is very small and its accurate measurement is possible only by means of sensitive instruments like extensometers, interferometers, or ultramicrometers.

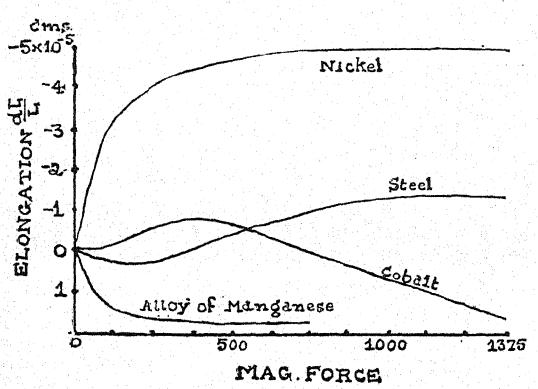

FIG. 1

The curves in Fig. 1 illustrate the influence of magnetic fields in the case of iron, cobalt, nickel and an alloy of manganese. Iron shows an increase in length for weak fields and decrease for strong fields. Nickel exhibits a shortening for all field strengths and the Heusler alloy behaves in quite the opposite way. Cobalt behaves in a manner just the opposite of iron. It has also been found that there is hysteresis attending the Joule Effect and it is closely related to the familiar magnetisation hysteresis.

In addition to the change of length, it has been found that the area of cross-section changes when the rod is magnetised longitudinally (the so-called *'transverse Joule Effect'*). There is also a change in the Young's modulus consequent on magnetisation. Wiedemann discovered that due to the interaction of longitudinal and circular magnetic fields a twisting of the specimen ensues (*'Wiedemann Effect'*). The coefficient of rigidity is affected considerably by change in magnetisation. Barett showed that the volume of a magnetic material changes if its magnetisation is altered (*Barett Effect*).

Changes in Magnetisation due to Mechanical Deformations

The effect of mechanical deformations on the magnetisation discovered by Villari is of great interest. Villari found that if an iron rod is stretched its intensity of magnetisation increases in a weak magnetic field but decreases in a strong field. This is known as the *Villari Reversal Effect* and the point V

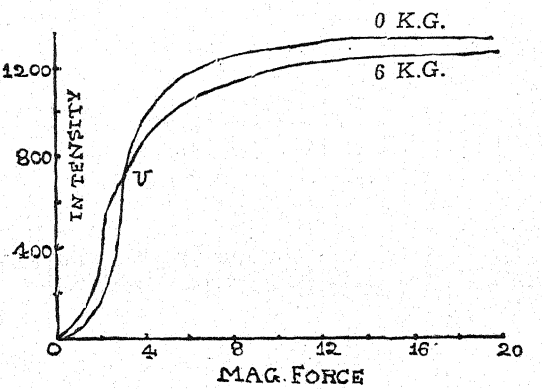

FIG. 2

where stretching or compressing does not affect the intensity of magnetisation is known as the Villari Reversal Point. The *Villari Effect* is the reciprocal of the Joule Effect. A change in magnetic induction due to normal stress has also been shown to exist and is known as the *"transverse Villari Effect"* as against the transverse Joule effect.

Wiedemann has found that if a circularly magnetised rod is twisted it develops longitudinal magnetisation (*Second Wiedemann Effect*) and Wertheim, that a longitudinally magnetised rod when twisted develops circular magnetisation (*Wertheim Effect*). Nagaoka and Honda have shown that a change in the volume of the specimen is accompanied by a change in its state of magnetisation (*Nagaoka-Honda Effect*). This is the opposite of the *Barett Effect.*

In all these experiments great care must be taken to maintain the external conditions such as temperature and pressure constant. The exact nature of the change in any specimen depends upon its previous history (thermal treatment, magnetisation, stresses and the like) and may be considerably altered by processes such as annealing. The actual magnitudes of these changes being very small, special devices have to be employed to measure them. A detailed account of these various effects and their measurements is given by S. R. Williams.[1]

Single Crystals of Magnetic Materials

It is obvious that work with single crystals would be more useful in disclosing the nature of the magnetostriction phenomenon than with samples of polycrystalline material about the history and structure of which little is generally known. Webster,[2] Honda and Mashiyama[3] have studied the Joule effect in single crystals of iron using different orientations of the specimen. They find that the Joule effect exhibits anisotropy, its sign and magnitude depending upon the orientation. The effects are much larger in single crystals than in the polycrystalline metal. Takaki[4] has studied the variation of the magnetostriction of iron crystals with temperature. The behaviour of the crystal is markedly different along different crystallographic axes. Similar experiments have been made by Nishiyama[5] and Mashiyama[6] on crystals of cobalt and nickel.

Alloys of Magnetic Materials

Studies of magnetostriction in alloys of magnetic materials have been carried out by Schulze,[7] Mashiyama[8] and others. It is interesting to observe the gradual change exhibited by iron-nickel alloys with varying percentages of nickel. The curves in Fig. 3

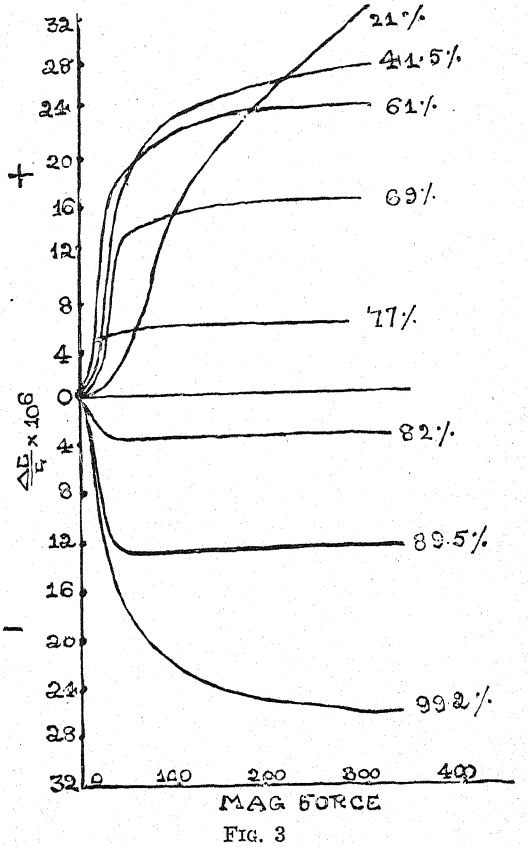

Fig. 3

illustrate this strikingly. With small percentages of nickel the curve is seen to be entirely positive, while with nearly pure nickel the curve is practically inverted. The change from positive to negative is continuous with increasing percentages of nickel, with the result that an alloy in which there is no magnetostriction whatever the magnetising force, is possible and does in fact occur at about 80% nickel. This alloy is the well-known *'permalloy'* in which the magnetic permeability is very high for small values of the magnetising force. In the case of the silicon-steel alloys there appears to be some evidence that at a percentage of silicon slightly above that used for stalloy, the

curves from being similar to that in iron tend suddenly to invert as in the case of nickel-iron.

Para- and Dia-Magnetic Materials

In ferromagnetic substances, magnetostriction is easily observed in ordinary magnetic fields. In para- and dia-magnetic substances, however, no magnetostriction is observed at such fields. Kapitza[9] made a study of non-ferromagnetic substances using very intense fields. The measurements in strong fields lasted only for a fraction of a second and hence had the advantage that while the scale of the phenomenon was much magnified, all disturbances due to accidental variations in temperature were eliminated. He also made an extensometer, capable of measuring to 10^{-7} cm. which was as sensitive in the brief time of experiment as those used for long duration measurements. Using single crystals of bismuth, Kapitza found that magnetostriction was very closely connected with crystal orientation both as regards its sign and magnitude. Variation of the effect due to changes in field strength, changes in temperature, and addition of impurities were studied. Some effects were also observed in antimony, graphite, gallium and other substances.

The phenomenon of magnetostriction is of fundamental importance in the theory of magnetism. It has been the usual practice in building up theories of ferromagnetism to ignore effects such as these and then by rather arbitrary additions to give them place within it. Of late, however, several attempts have been made to include the magnetostrictive data in the foundations of a theory of ferromagnetism. McKeenhan,[10] Fowler and Kapitza[11] have considered the question. Kapitza has also discussed the results he has obtained with diamagnetic materials in relation to the modern theory of diamagnetism. However, it may be said that only a beginning has been made in this direction. The study of magnetostriction promises to throw light on the subject of interatomic forces in solids and the architectural design of the elementary magnet, the atom. It is of great importance therefore to obtain accurate data in ferromagnetic as well as non-ferromagnetic substances under specified conditions. Study of other phenomena which are related to magnetostriction such as the change in resistance in a magnetic field, change in thermo e.m.f. due to a magnetic field, e.m.f.'s due to magnetisation and the Barkhausen Effect on the same specimens of material may provide the theoretical investigator with useful information.

The Magnetostriction Oscillator

The principle of magnetostriction has found several practical applications in the laboratory and elsewhere. What appears to be of rather great significance is the development of valve oscillating circuits whose frequency can be controlled by the utilisation of the magnetostriction effect, and conversely of circuits which can maintain intense vibrations based on the same principle. The first "magnetostriction oscillator" was set up by Pierce[12] ten years ago, in which the frequency was controlled magnetostrictively. The circuit used (Fig. 4) is essentially a Hartley

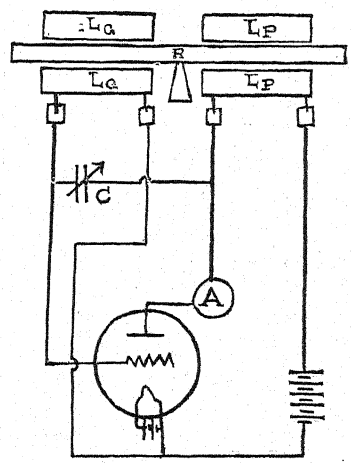

Fig. 4.

arrangement with two separate grid and anode coils, which are tuned by a variable capacity C. The spatial coupling between the coils is loose, and the magnestrictive rod is placed axially in the centre of the two coils, supported at its midpoint. When the oscillating circuit is tuned to near the natural frequency of the rod, an additional coupling due to magnetostrictive action arises thus: a small change of current through L_p changes the magnetisation of the rod, which thereby suffers a change in length. This deformation of the rod transmitted to the grid coil side, causes an equivalent change in magnetisation and induces an e.m.f. in the coil L_g. This induced e.m.f. on the grid

produces an amplified change in the plate circuit and thus in L_p. This coupling is maximum at the natural frequency of the rod and the oscillations are maintained at the same frequency. More recently Pierce[13] has developed an oscillator which functions only under the control of the vibrating rod, and is inactive otherwise.

Magnetostriction Oscillator used as a Frequency Standard

Extensive investigations have been made by Pierce and his collaborators on the development of magnetostriction controlled frequency standards. The material suitable for use as a vibrator must have a large magnetostrictive effect and must maintain constancy of frequency in spite of changes in temperature, magnetisation, condenser settings and vacuum tube characteristics. For these purposes iron and irons with various carbon contents are found to be relatively useless, as they have too small magnetostriction coefficients. Pure nickel, and alloys of nickel and iron, or alloys of cobalt and iron, nichrome and monel metal are found to be very powerful vibrators. The temperature effects can be overcome by using composite vibrators, consisting of a tube of one material and a core of different material, the two having opposite coefficients of expansion. In order to prevent undue lengths at low frequencies, nickel tubes filled with a material such as lead in which the velocity of sound is small are used.

The magnetostriction oscillator is found to be effective in the range between the very low audible frequencies and nearly two million cycles per second in the supersonic range. Harmonics can be developed up to frequencies of several million cycles per second. Above 300,000 cycles per second, however, the vibrations are found to be too feeble. In the range between 300,000 cycles and 25,000 cycles per second, the magnetostriction oscillators and the piezo-electric oscillators have a common range of usefulness. Below 25,000 cycles per second however, *i.e.*, in the upper audible range, on account of the difficulty of obtaining sufficiently large crystal vibrators, the magnetostriction oscillator is very useful. The constancy of frequency of the magnetostriction oscillator compares favourably with that obtained by the piezo-electric crystal oscillators.

Magnetostrictive standards of frequency have been set up by Pierce and his coworkers. They have been used to control electric circuits in the apparatus for supersonic research such as superhet sonic amplifier, standard signal generator and microvoltmeter and in the calibration of wavemeter and frequency meters. The velocity of sound in various metals and alloys have been measured and their elastic constants (with their temperature coefficients) have been obtained. By using the vibrator as a source of sound, the transmission of sound over reflecting surfaces has been investigated.

The relevant literature on these developments is largely to be found in the *Journal of the Acoustical Society of America*, 1938, Vol. 9.

Oscillators of very High Amplitude

Newton Gaines[14] was the first to study the effects at very high amplitudes of the oscillator. The object was to increase the power input of the resonant magnetostrictive nickel tubes to the limit set by the mechanical properties of nickel and then to discover and investigate properties of the intense sound produced by longitudinal vibration. The apparatus is essentially a high power oscillator with the nickel tube mounted axially in the field of the coils.[15]

With a vibrator of this type it is found that the amplitudes of vibration could be easily measured with ocular micrometers. The amplitudes are so high that nickel tubes are quickly ruptured. The sound produced is of sufficient intensity to cause pain to the unprotected ear. Metal plates, when held at one end to touch the rod are found to be eroded. When the sound beam is directed on to a beaker or a flask, the vessel is broken. A piece of cork driven into the tube is found to be burnt. The vibrations produce a considerable emulsifying effect, stable emulsions of transformer oil, benzene and mercury in water being easily obtained. Dispersions of carbon and other substances could be obtained. When introduced into a vessel of water from below, fountains as high as 9 cm. are produced. All these disruptive effects are due to cavitations produced by the intense sound waves. Chambers[16] reports that there is emission of light from the cavity in the case of some liquids (fourteen liquids, among the

thirty-six examined show this effect). Using a magnetostriction oscillator, Porter and Leona Young[17] have shown that a molecular rearrangement can be brought about by powerful ultrasonic waves. Salisbury and Porter[18] have constructed a very powerful magnetostriction oscillator which operates with a power input which can be varied continuously between 0 and 2000 watts in order to use it as a source of intense ultrasonic waves in connection with their experimental work on the mechanisms of some organic reactions. The oscillator was also satisfactorily adopted by Gaines and Chambers, to form a continuous laboratory process for the sterilization of market milk. One of the most important applications of magnetostriction is found in the magnetostriction echo depth recorder[19] which is used for taking soundings at sea and has now reached the stage of being produced commercially.

SUMMARY

The phenomena which have been grouped together under the heading "*Magnetostriction*" are briefly described. Experimental results on the magnetostriction of ferro-, para- and dia-magnetic substances, single crystals and alloys are considered and the theoretical importance of the phenomenon pointed out. The development by Pierce of the magnetostriction oscillator and its importance as a frequency standard has been indicated. Use of oscillators of very high amplitudes in the laboratory for the investigation of physico-chemical problems and their important industrial applications have been mentioned. The article is in the nature of a review of the recent progress made in the subject of magnetostriction that has become one of great importance.

The author of this article feels grateful to his Professor, Sir C. V. Raman, F.R.S., N.L., who gave him facilities to set up a magnetostriction oscillator in his laboratory at the Indian Institute of Science, Bangalore.

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LETTERS TO THE EDITOR

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Garo Hill Cotton

In the course of testing samples of cotton at the Technological Laboratory received from different parts of India, a sample of Garo Hill cotton from Assam was subjected to fibre and spinning tests. These tests revealed that this cotton possesses a number of exceptional features which are described below as they may be of interest to those working on cotton. The sample in question was supplied by the Deputy Commissioner, Garo Hills, Assam, to whom the writer is also indebted for the relevant agricultural details.

This cotton is grown in the northern half of the Garo Hill District. The soil is of the sandy loam and black clay type and the seed is sown in April/May. The picking is done in January and February nearly eight to nine months after sowing, while from May to September the crop receives a very heavy rainfall, which, in the current year, amounted to nearly 112 inches. There was, in addition, a rainfall of 7½" in April and over 4" in October; the total rainfall in the current year being nearly 124 inches.

The seed of this cotton is somewhat larger than that of *desi*-type and is densely covered with lint. The ginning percentage was found to be 49·8, the lint from 100 seeds weighing 8·05 grams, while the seeds themselves weighed 8·1 grams. The high ginning percentage is especially noteworthy.

The results of the fibre tests made on this cotton are given below in Table I.

Table I

Fibre Particulars

1. Fibre-Length Distribution (Balls Sorter):

Mean group length in eighths of an inch	Percentage
	Garo Hill Cotton
2	2·3
3	5·1
4	15·2
5	35·8
6	30·1
7	8·9
8	2·6

2. Fibre-length (inch)		
(*a*) By Bulls Sorter	..	0·65
(*b*) By Baer Sorter	..	0·66
3. Fibre-length irregularity (%)		14·9
4. Fibre-weight per inch (Millionth of an oz.)	..	0·391
5. Fibre-strength (oz.)	..	0·221
6. Intrinsic strength	..	0·57
7. Ribbon width (thousandth of an inch)	..	0·98
8. Swollen diameter (thousandth of an inch)	..	1·49
9. Maturity (%) ..	..	77–14–9
10. Standard hair-weight (Millionth of an oz.)	..	0·380
11. Convolutions per inch	..	69
12. Wax Content (%)	..	0·212

It will be noticed that the cotton is a short stapled type, having a staple length of only about 5/8" but the most remarkable features about it are its high fibre-weight per inch, ribbon width and swollen diameter. Hitherto, nearly 5,000 samples of cotton have been tested at the laboratory, and in all probability the values of these three properties of this cotton are highest on record here; while owing to its high fibre-weight per inch, the intrinsic strength (the fibre-strength per unit fibre-weight per inch) is probably the lowest on record. Another remarkable feature about this cotton is its extremely low wax content, which again is the lowest on record in this Laboratory. This low wax content gives it a peculiar harsh feel, which is very characteristic of the cotton. Furthermore, for its length, this cotton possesses rather high fibre-length irregularity percentage and rather low percentage of mature fibres.

The cotton was also subjected to a spinning test in the Laboratory, and it was found that, even with a moderately high twist, the 6's warp yarns spun from it did not possess the requisite strength. This is due partly to its low staple length and partly to its high fibre-weight per inch. The cotton, however, though not so suitable for spinning purposes, would be excellent, owing to its harsh feel, for mixing with wool; also, provided it could be given a softening treatment, it would form a suitable material for the manufacture of hospital lint after removing the small amount of wax associated with it.

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Biochemical Synthesis of Colouring Matter by an Indian Strain of Penicillium Mold

THE chemistry of colouring matters synthesised in higher plants has received considerable attention lately and the constitution of some have already been established. Colouring matters are also produced by some of the lower plants like molds and actinomycetes, the colour being usually located within the mycelium or cells and in a few cases it diffuses out into the culture medium. The colouring matters of the lower plants have not been studied systematically at all except in isolated cases by a few workers like Raistrick,[1] Friedheim,[2] Blochwitz,[3] and Griegarieva-Manoilova and Poradieeva,[4] etc. Amongst the Penicillium group of molds, although the fact that they have the capacity of producing pigments is known, systematic attempts at elucidating the constitution of the pigments or the mode of their synthesis are extremely rare, the only work in this field being that of Friedheim who has experimented with *Penicillium phœnicum*.[3] This is probably due to lack of suitable micro-organisms which can produce pigments in experimentally workable amounts. Therefore the isolation from an indigenous source of a species of Penicillium which readily yielded scarlet coloured culture solutions has afforded an opportunity of studying the interesting problem of colour production. The present note is a preliminary report of the work so far done.

Whilst carrying out a survey of the microflora habitating on fruits of Northern India a mold was encountered on some of the samples of over-ripe William pears obtained from Kulu valley in the Punjab, which appeared to belong

to the Penicillium group of fungii and was an efficient producer of brilliant red to scarlet coloured pigment. It may be interesting to note that Galloway[5] has found the acid soils of the hilly districts of India to be abundantly infested with Penicillium molds. In order to obtain the mold in pure culture the infected fruit was scraped and the scrapings shaken in physiological saline and the latter plated out in suitable decimal dilutions on oatmeal-maltose-agar or potato-maltose-agar medium. The discreet colonies of the chromogenic mold were picked out and replated after having been successively grown a few times on a medium consisting of: maltose 0·5%, aspargine 0·1% and potassium phosphate 0·01%. This medium is obviously unfit for the vigorous growth of yeasts and is therefore suitable for freeing the mold from yeasts and even fungii imperfectii which occur abundantly on the fruits.

Culturally the mold strongly resembled the Penicillia. On liquid media it has a greyish white occasionally yellowish growth. In forty eight hours the colour of the mycelium becomes green on account of the appearance of spores and the medium starts turning red. After 2-3 weeks the medium is deep red and the mycelium consists of dense closely woven hyphæ, the surface is deep green and the reverse velvity and red-brown in colour. On malt agar the vegetative growth is restricted, dense but irregular, spores abundant, conidial areas deep green, the medium rapidly turns deep red. The cultures on agar were sent to the centraalbureau voor Schimmelcultures *Baarn* Holland and have been stated to be identical with *Penicillium crateriforme* isolated by Gilman and Abbot[6] in 1927 from the soils of Louisiana, Iowa and Utah States in America. It may be pointed out that climatically there is a resemblance between the above mentioned American States and the Indian district from where the present strain was isolated. The somewhat surprising fact should here be mentioned that Oxford and Raistrick[7] in a study of biochemistry of '*Penicillium crateriforme* Gilm and Abb' in which they have used the well-known Czapek-Dox medium have failed to notice any reddening of the culture solution even after twelve weeks; only the mycelium is stated by them to acquire in the later stages a faint pink or occasionally a brick-red colour.

The physiological needs of this mold are quite simple, a small amount of carbon source and a trace of nitrogen being all that is necessary. Such simple sources of carbon as ethyl alcohol, ethylene glycol, glycerine, isopropyl alcohol, acetone and lactic acid are assimilated although growth is more prolific with more complex carbohydrates. For the production of colour organic nitrogen compounds of intermediary complexity like amino-acids, peptides and peptones are more suitable nutrients than inorganic nitrogen on the one hand and albumins and proteins on the other. Amongst the sugars pentoses like arabinose and xylose are the most suitable substrates for colour production. Laevulose is converted slightly more readily than dextrose; galactose, mannose, sucrose and maltose and also to a lesser extent lactose readily yield the colouring matter, whilst trehalose, raffinose and to a small extent also dulcite and mannite give the red pigment. Dextrin gives little or no colour. In order to get comparable results in such experiments the coloured medii were collected at the end of a definite number of days, filtered, made to known volume and the amount of pigment produced compared in the Lovibond tintometer. Triplicate lots of medii were taken in each case in order to avoid experimental error which is otherwise very large. From the point of view of elucidation of mechanism of the pigment synthesis, it is naturally important to find out the simplest carbon compounds which can be utilised by the mold-enzymes in building up the complicated pattern of the pigment molecule and here experiments with pregrown mycelium have brought out the interesting fact that a number of simple carbon compounds can be converted into the colouring matter. The mold was first grown on a sucrose medium, the mycelium collected, washed well, cut into small

round pieces and placed on the surface of the new media under examination; precautions being taken during the whole operation to avoid extraneous infection. Blank tubes with distilled water were used as controls and their Lovibond tintometer values subtracted from those obtained with the actual medii. In this way it has been found that the following substances readily give the pigment: methyl and ethyl alcohols, glycerine, amyl alcohol, etheylene glycol, tartaric, dihydroxytartaric, citric and mucic acids, and acetone. It is quite likely that synthesis of the pigment from the carbohydrates proceeds *via* any of these compounds.

For the large-scale production of the pigment sucrose has been selected as the substrate on grounds of convenience and economy. The medium contained in flasks consists of sucrose 0·5%, Bacto peptone 0·10% and potassium phosphate 0·01%, final pH after autoclaving or steam sterilisation at 100° C. was about 6. After inoculation with spores of the organism from an agar culture, the flasks were incubated at 30° C. Red colour begins to appear in about three days from the top and the colour slowly extends and the whole liquid turns red in one or two weeks, maximum reaching in about 2–3 weeks. The culture liquid is decanted off from the mycelium, filtered, mixed with 10–15% its volume of hydrochloric acid, left aside for half an hour and then extracted with about 30–35% its volume of amyl alcohol used in two portions. The amyl alcohol extracts are washed once with water, dried over sodium sulphate and the solvent distilled off *in vacuo*. The residual pigment is stirred up with a little ether or petroleum ether which dissolves out a brownish impurity, and the pigment is collected. This gives a deep red to chocolate coloured powder in a yield of about 0·100 gm. per litter of the culture solution. The crude pigment melts indefinitely between 180–200° C., can be adsorbed on suitable grades of alumina, and is precipitated from aqueous solutions with lead acetate. With ferric chloride no detectable deepening of colour occurs but strong acids or alkalies turn the bright red colour of an aqueous solution to an orange colour. It is oxidised to colourless form by boiling with hydrogen peroxide. It is insoluble in usual organic solvents, but dissolves readily in amyl alcohol from which it is not easily washed out with water. An aqueous solution appears deep red in ordinary light and greenish-brown under the mercury vapour lamp. The biochemistry of the synthesis of the pigment is being studied and its constitution will be examined when workable amounts have been prepared.

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[1] Raistrick, H., and co-workers, *Phil. Trans.* (B), 1931, **220**, 209, 269, 297; *Biochem. J.*, 1932, **26**, 1907; 1933, **27**, 1170; 1934, **28**, 559, 1640; 1936, **30**, 1303; 1937, **31**, 385; *J. Chem. Soc.*, 1933, 488; 1937; 80.

[2] Friedheim, E. A. H., *Biochem. Z.*, 1933, **259**, 257; *Compte rend. Soc. Biol.*, 1933, **112**, 1030.

[3] Blochwitz, A., *Ber. deutsch. bot. Ges.*, 1931, **49** (6), 319.

[4] Grigorieva-Manoilova, O. C., Poradieeva, N. N. *Arch. Sci. Biol.* (Petrograd), 1915, **19**, 119; *Abst. Bact.*, **7**, 333.

[5] Galloway, L.D., *Ind. J. gr. Sci.*, 1936, **6**, 582.

[6] Gilman, J. C., and Abbot, E. V., *Iowa State Coll. J. Science*, 1927, **1**, 3, 225; *Biol. Abs.* 1928, **2**, No. 18643.

[7] Oxford, A. E., and Raistrick, H., *Biochem. J.*, 1934, **26**, 1321.

Diet and Detoxication

During the present year, an investigation has been undertaken in this laboratory with a view to answer the question, "Can the rate of elimination of conjugated glucuronic acid be used to test the metabolic function of the liver?" In this connection, a large number of estimations were conducted, by an improved and comparatively recent technique,* on conjugated

* Salt's modification[1] of Tollen's naphthoresorcinol test has been used throughout these experiments. The final blue-violet colour of the ethereal extract was examined in a Pulfrich photometer, using filter, No. S. 53 with a wave length of 530 μ, and the result expressed in terms of the colour absorption (extinction co-efficient), which, according to Salt, (1935) is proportional to the quantity of glucuronic acid excreted.

glucuronic acid elimination in 24-hour samples of urine in rabbits and dogs, kept in metabolism cages under standard conditions with respect to diet, etc. Two sets of observations were recorded:—

(*a*) The normal rate of day-to-day glucuronide elimination in rabbits and dogs, maintained under standard conditions for at least 7 days prior to experimentation, is shown in Table I.

TABLE I

	Animal No.	Sex and Wt. (kg.)	† Excretion in 24 hours — Days		
			1	2	3
Rabbits	7	M. (1·28)	1·3	1·4	1·5
	8	M. (1·33)	1·5	1·5	2·1
	9	M. (1·15)	1·7	1·9	2·3
	16	F. (1·43)	2·1	2·7	3·1
Dogs	1	F. (4·76)	40	43	44
	2	F. (4·90)	34	35	43
	3	F. (6·40)	40	45	49
	4	F. (5·40)	30	34	35

† Average of three determinations in each case.

It will be apparent that in the rabbit, the normal glucuronide excretion level is rather low (range bet. 1 and 4), while in the dog, it is very much higher (range bet. 40 and 50). This difference does not appear to be only a difference in degree (as it cannot be explained on the basis of the differences in the body weight) but is probably indicative of a fundamental difference in the nature of the detoxication mechanism (detoxication through conjugation with glucuronic acid in the liver) in the two animals.

(*b*) To determine whether the degree of response of these two animals, when their livers were exposed to a strain through the administration of a glucuronogenic drug, *e.g.*, chloral hydrate, was identical or not, proportionate doses (calculated on the basis of body weight) of chloral hydrate were administered orally and the effects on conjugated glucuronide elimination noted (Table II).

Here again, a definite difference in reaction between the two animals was noticeable. While both the animals responded to the glucuronogenic drug by showing an appreciable increase in the hepatic glucuronide formation and elimination, the amount of chloral necessary to bring about this change varied in the two animals. The 'effective dose' (dose just

TABLE II

	Animal No.	Sex and Wt. (kg)	* Excretion after chloral Hydrate in 'effective dose' (mgms. per kgm.)					
			100	150	200	250	350	450
Rabbits ..	7	M. (1·28)	..	..	..	3·9	2·1	10·8
	8	M. (1·33)	..	..	..	1·8	2·0	12·0
	9	M. (1·15)	..	..	..	1·9	5·0	..
	16	F. (1·43)	..	..	..	2·7	5·1	..
Dogs ..	1	F. (4·76)	60	80	125	..	..	..
	2	F. (4·90)	57	75	110	..	..	..
	3	F. (6·40)	..	..	115	..	..	..
	4	F. (5·40)	..	..	90	..	..	..

* Average of 3 determinations in each case.

sufficient to bring about a measurable increase in glucuronide excretion in 24-hour urine) of chloral in the rabbit varied from 250 mg./kg.–450 mg./kg. Much smaller amounts were needed in the dog, the dose ranging between 100 mg./kg.–200 mg./kg.

From the results obtained, there is little doubt that significant differences exist in the two animals with regard to the rate of hepatic glucuronide formation and elimination. While engaged in a study on cyanide detoxication a few years ago, the senior writer[2] observed a similar difference in the rate of cyanide conversion (into thiocyanate) by the rabbit and the dog. Under ordinary conditions, –CN introduced into the system, is detoxified by being converted into –SCN, the thio-constituents of the body supplying the necessary sulphur. In the rabbit, an almost complete conversion of –CN to –SCN takes place, as evidenced by the recovery of nearly 98 per cent. of administered cyanide as thiocyanate in the urine in about 3 days. In the dog, on the other hand, not more than 24 to 65 per cent. (average 40%) of –CNS equivalent of –CN injected can be recovered in more than a week's time. This difference in the process of cyanide detoxication in the two animals—the rabbit and the dog—lends additional support to the observations already recorded regarding the differential elimination of conjugated glucuronide in the rabbit and the dog.

As the *rabbit* is a typical representative of the herbivorous group of animals and the *dog* of the carnivorous group, it will be of interest to enquire whether the mechanism of detoxication is in any way dependent on the nature and composition of the diet. This speculation is strengthened by the interesting experiments of Miller and Connor,[3] who suggest that glucuronic acid for detoxication purposes can be derived from *food* sources. That the food material has an influence on the efficiency of another detoxication process has been demonstrated by Abderhalden and Wertheimer[4] in the cases of the formation of mercapturic acid and hippuric acids in the rabbit. According to Miller and Connor,[3] the *rabbit* is unable to synthesize glucuronic acid from carbohydrates or amino-acids (or at least performs these syntheses very slowly) but that it can utilise glucuronic acid to a certain extent from its food supply. Guinea pigs apparently behave in the same way as rabbits with regard to glucuronic acid formation (Miller, Siehrs and Brazda).[5] Miller *et al*[6] have shown that the *dog* possesses a store of glucuronic acid, or can synthesize it from carbohydrates and amino-acid metabolites. These evidences indicate that at least as far as glucuronic acid metabolism is concerned, the two animals may behave differently.

A pertinent question that may be raised in this connection, "Is the carnivorous dog better adapted to withstand the introduction into the system of certain poisons than the herbivorous animals?" As far as the conjugation mechanism with glucuronic acid is concerned, the dog is apparently better fitted for struggle against toxins of the type ordinarily detoxified through this mechanism, as it can readily mobilize glucuronic acid from endogenous catabolism which the herbivorous animals are not capable of doing. However, this lack of 'conjugation power' does not necessarily indicate that herbivorous animals like the rabbit and the guinea pig are less capable of neutralising poisons introduced into their body than the dog. Detoxication, which consists essentially in the destruction of a toxic compound or in changing a physiologically active chemical group to one which is less so, is brought about by one or other of the processes of *oxidation, reduction* or *conjugation.* It is not improbable that in the herbivorous animals the processes of oxidation and reduction may play a more important part than conjugation whereas in the carnivorous animals like the dog, the reverse may be the case.

The interesting inter-relationship between diet and detoxication is obviously a problem of considerable significance in connection with the biochemical defence mechanisms of the body and in clinical medicine generally. This note is published with the idea of eliciting opinion and of focussing more interest on this subject.

We are grateful to Prof. R. N. Chopra for guidance and help in this investigation.

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[1] Salt, *Biochem. J.*, 1935, **29**, 2705.
[2] Mukerji, "Doctoral Dissertation on Thiocyanate metabolism in cyanide poisoning," *University of Michigan Publication*, 1936.
[3] Miller and Connor, *Proc. Soc. Exp. Med. Biol.*, 1933, **30**, 630.
[4] Abderhalden and Wertheimer, *fluger's Arch.*, 1925, **207**, 215; **209**, 611.
[5] Miller, Siehrs and Brazda, *Ibid.*, 1933, **30**, 636.
[6] Miller, Brazda and Elliot, 1933, *Ibid.*, **30**, 633.

The Principal Magnetic Susceptibilities of Tellurium Crystal

MCLENAN AND COHEN[1] studied the magnetic properties of single crystals of tellurium and found that the diamagnetic susceptibilities along and normal to the trigonal axis had the same value. A study of the crystal structure of tellurium by Bradley[2] led him to emphasise the uniqueness of the trigonal axis in the crystal.

In this investigation, tellurium crystals were produced by the method of slow cooling. The principal magnetic susceptibilities were determined by the Guoy method.[3]

The principal susceptibilities are found to be — 0·329 parallel to the trigonal axis and — 0·296 perpendicular to the trigonal axis.[4] This leads to a value of 1·11 for the magnetic anisotropy of the crystal. The susceptibility of well-annealed polycrystalline tellurium is found to be — 0·307. This value agrees favourably with those obtained by previous investigators.

When a tellurium crystal is heated, the susceptibility parallel to the trigonal axis decreases, while the other principal susceptibility remains constant. At about 220° C., the two principal values become equal. When the solid melts at 450° C., the volume susceptibility decreases from — 1·7 to — 0·3.

The influence of small admixtures of tin, cadmium, bismuth and lead on the magnetic properties of tellurium single crystal was also investigated. In all the cases, both the principal diamagnetic susceptibilities show a decrease in value. The magnetic anisotropy tends to unity. The diamagnetic susceptibility in the polycrystalline state also shows a decrease. This decrease is found to be larger, the greater the atomic radius of the element introduced. The number of valence electrons in the atom of the added element does not seem to have any influence on the decrease in the mean susceptibility of tellurium.

The atomic susceptibility of polycrystalline tellurium is found to be — 39·2 while according to Kido,[5] the susceptibility of a gram ion of tellurium (Te^{+6}) is — 4·5. The contribution to the total atomic susceptibility of the element by the six valence electrons is — 34·7. This indicates that probably the linkages of the six electrons are not metallic. Tellurium behaves like a nonmetal from the magnetic point of view. This conclusion is substantiated by the large electrical resistance of the element.

Full details will be published elsewhere.

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September 4, 1939.

[1] *Roy. Soc. Canada, Trans.*, 1929, **23**, 159.
[2] *Phil. Mag.*, 1924, **58**, 477.
[3] *Proc. Ind. Acad. Sci.*, 1936, **4**, 186.
[4] Susceptibility values are given in 10^{-6} units.
[5] *Sc. Rep. Tohoku Imp. Univ.*, 1933, **22**, 835.

Determination of Dipole Moment in Solution

THE apparent electric moment of ortho-, meta- and para-nitrotoluene is measured in a number of solvents. When polarization at infinite dilution is determined using P_2—f_2 curves, it is found that wherever P_2 changes rapidly with

f_2 the extrapolated value $_\infty P_2$ becomes uncertain. Hedestrand's method of mathematical extrapolation to infinite dilution[1] is found to be convenient so long as the variation of ϵ and d with f_2 is linear. When this is not the case graphical extrapolation of $\alpha\epsilon_1$ and βd_1 to $f_2 = 0$ has to be used, and the values are subject to the inaccuracies of graphical methods.

The Sugden relation[2] $P_2 = A \pm B\frac{\epsilon-1}{\epsilon+2}$ is found to hold for all the solutions investigated. This relation can be used to calculate $_\infty P_2$ which is the value of P_2 at $\frac{\epsilon_1-1}{\epsilon_1+2}$, ϵ_1 being the dielectric constant of the solvent. Since the Sugden relation is linear $_\infty P_2$ can be calculated by mathematical computation. $_\infty P_2$ so calculated is found to agree, wherever possible, with the values obtained from graphical extrapolation and Hedestrand's method. The constants A and B, however, do not carry the significance originally attached to them by Sugden.[2]

In order to correlate the values of $_\infty P_2$ and the dielectric constant ϵ of the solvent it was assumed that $_\infty P_2 = a\epsilon^b$ where a and b are constants. Hence $\log P_2 = \log a + b \cdot \log \epsilon$. The plot of $\log {}_\infty P_2$ against $\log \epsilon$ for solutions of ortho-, meta- and para-nitrotoluene in different solvents shows three parallel straight lines. When the slope of these lines is calculated using the method of least squares the following result is obtained :

Solute	Slope	Correlation coefficient
o-Nitrotoluene	−0·4928	1 − 0·004
m-Nitrotoluene	−0·5256	1 − 0·010
p-Nitrotoluene	−0·5012	1 − 0·004

Thus for the substances investigated $_\infty P_2 = a/\sqrt{\epsilon_{\text{solvent}}}$. This empirical relation differs from the relation $_\infty P_2 \propto 1/\sqrt{\epsilon_{\text{solvent}}}$ suggested by Jenkins.[3] When $_{\text{gas}}P_2$ is calculated from the empirical relations by extrapolating the graph to $\epsilon = 1$ widely different values are obtained. Thus we have :

Substance	Müller	Sugden	Author	Jenkins
	c.c.	c.c.	c.c.	c.c.
o-Nitrotoluene ..	369	454	487	556
m-Nitrotoluene ..	451	552	608	692
p-Nitrotoluene ..	503	618	666	751

It is found that no agreement is possible between $_{\text{gas}}P_2$ derived from different empirical relations so long as extrapolation is carried out to $\epsilon = 1$. From a reconsideration of the data in hand it appears that there is good reason to suspect the validity of extrapolation to $\epsilon = 1$ for the gaseous state. The empirical relations have been derived from results obtained from measurement on solutions and as such may be considered as applicable only so far as the liquid state is concerned. Once the transition from a liquid state to a gaseous state sets in there is no evidence to assume that the prolongation of the graph in that form is valid. On the other hand, it seems reasonable to assume that during transition the changes in the dielectric constant are unaccompanied by changes in the molecular polarization. This leads us to assume a horizontal portion on the graph $P_2 - \frac{\epsilon-1}{\epsilon+2}$ after the transition point is reached. This constant value of P_2 may be taken as $_{\text{gas}}P_2$.

Le Fèvre[4] has found that the dielectric constant of benzene, carbon tetrachloride, carbon disulphide and other liquids is nearly the same at the critical temperature of the respective liquids. This may be called the critical dielectric constant. Assuming the constancy of the critical dielectric constant a rough idea may be obtained about the magnitude of the dielectric constant when the transition is occurring at room temperature. For benzene the critical dielectric constant given by Le Fèvre is 1·35. The transition dielectric constant ϵ at temperature $t°$ C. may be calculated from $\epsilon_t = \epsilon_c + \frac{d\epsilon}{dt}(t - T_c)$ where T_c = critical temperature, ϵ_c critical dielectric constant, and

$\frac{d\epsilon}{dt} = -0{\cdot}002$. The transition dielectric constant works out to be 1·88 for benzene at 20° C.

As a preliminary, the results of Parts[5] for solution in benzene of *iso*-propyl chloride, *iso*-propyl bromide, *sec*-butyl bromide, and *n*-butyl iodide are recalculated using the Sugden relation $P_2 = A - B\frac{\epsilon-1}{\epsilon+2}$ and evaluating P_2 for $\frac{\epsilon-1}{\epsilon+2} = 0{\cdot}2269$ ($\epsilon = 1{\cdot}88$). The electric moment calculated from this value is in good agreement with the value obtained by Groves and Sugden[6] from measurements in the gaseous state.

	Parts (recalculated)	Groves & Sugden
Iso-propyl chlorde ..	2·14	2·15
Iso-propyl bromide ..	2·18	2·19
Sec-butyl bromide ..	2·21	2·20
n-butyl iodide	2·07	2·08

When the Sugden relation is used for one solute in different solvents it is found that a value 1·7 for the transition dielectric constant yields concordant results. It may further be noted that when the relations of Jenkins and the author are each extrapolated to $\epsilon = 1{\cdot}7$ there is a general unification in the values obtained from the different relations.

$_{gas}P_2$ calculated from different relations

Substance	Müller c.c.	Sugden c.c.	Author c.c.	Jenkins c.c.
o-Nitrotoluene ..	369	368	374	385
m-Nitrotoluene ..	451	456	466	472
p-Nitrotoluene ..	503	513	511	521

As a further test the results of Müller[7] for nitrobenzene, acetone and chlorobenzene in various solvents were recalculated using the Sugden relation extrapolated to $\epsilon = 1{\cdot}7$. The same was done for Jenkins' results for nitrobenzene.[3] The agreement between the recalculated values and those determined from measurements in the gaseous state is good enough to support the assumptions.

	μ recalculated	μ gas
Nitrobenzene[3]	4·19	4·23
Nitrobenzene[7]	4·21	
Chlorobenzene[7]	1·69	1·69
Acetone[7]	2·85	2·85

The results are of a preliminary character. Work is in progress and detailed calculations will be published later.

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August 21, 1939.

[1] Hedestrand, *Z. physikal. Chem.*, 1929, **B2**, 428.
[2] Sugden, *Nature*, 1934, **133**, 415.
[3] Jenkins, *J.C.S.*, 1934, 482.
[4] Le Fèvre, *Trans. Farad. Soc.*, 1938, 1131.
[5] Parts, *Z. physikal Chem.*, **B7**, 327; **B12**, 312.
[6] Groves and Sugden, *J.C.S.*, 1937, 158.
[7] Müller, *Physik. Z.*, 1933, **34**, 689.

Photo-cells and the Measurement of Quantity of Light

THE use of a photo-cell for measuring the quantity of light corresponds to the use of a galvanometer for measuring the quantity of electricity. If light from a source of candle power (C.P.) be allowed to fall on a photo-cell of area A for a time Δt, then it can be easily shown[1] that

$$S_q\theta = KA\frac{(C.P.)}{r^2}\Delta t = KQ \quad .. \quad (1)$$

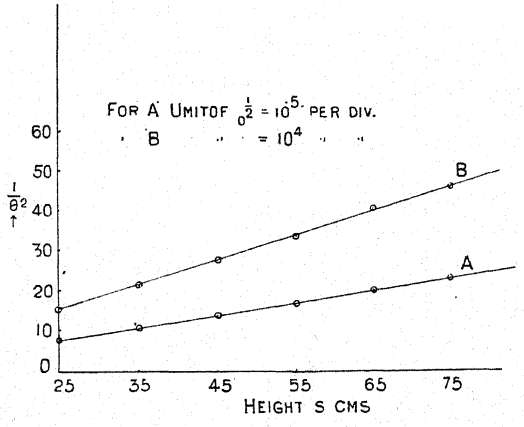
where S_q denotes the ballistic sensitivity of the galvanometer, θ the kick observed, r the distance between the photo-cell and the light source, Q the quantity of light and K is a constant.

We have determined the constant K by using two complimentary methods which may be called the light-flash method and the dark-flash method respectively.

In the light-flash method, a lamp of candle power 13·5 (15 watts) was allowed to fall from

different heights in front of a $Cu - Cu_2o$ photo-cell and the corresponding kicks in the galvanometer were noted. The duration of exposure $\triangle t$ was calculated from the knowledge of the height s of the lamp above the photo-cell and the acceleration of the system (lamp, weights, etc.). θ^2 was found to be inversely proportional to s as shown by the graph A in the figure. We obtained for K the value of $44{\cdot}8 \times 10^{-6}$ coulombs per lumen-second.

In the other (dark-flash) method, the lamp was placed directly in front of the photo-cell and the continuous light falling on the cell was interrupted for small intervals of time $\triangle t$ by allowing an opaque circular obstacle (of the same diameter as the aperture of the lamp-tube) to fall from different heights 's' in front of the lamp, the corresponding kicks ϕ of the galvanometer being noted. It was found that ϕ^2 was also inversely proportional to s (see graph B in the fig.).



From the theory of the ballistic galvanometer, it can be easily proved that the expression for the quantity of electricity passing through the galvanometer due to a current i in the circuit for a time $\triangle t$ also holds for the quantity of electricity *not* passing through the galvanometer due to a break of the current i in the circuit for the same time $\triangle t$. Since the quantity of light falling on the photo-cell for a time $\triangle t$ is proportional to the quantity of electricity passing through the galvanometer connected across it, it follows that the values of K obtained by both the above methods should be equal. We find, however, that the dark-flash method gives for K the value $55{\cdot}8 \times 10^{-6}$ coulombs per lumen-second.

To test this point further, the lamp was placed at different distances r in front of the photo-cell and the corresponding steady deflections of the galvanometer were noted. If S_c represents the current sensitivity of the galvanometer then

$$K'\left(\frac{C.P.}{r^2}\right) A = S_c\theta \quad .. \quad .. \quad (2)$$

where K' is another constant.

We got $K' = 50{\cdot}6 \times 10^{-6}$ amperes per lumen.

It will be seen that this value of K' lies midway between the two values of K, obtained above, by different methods and agrees remarkably well with their mean.

D. V. GOGATE.
Y. V. KATHAVATE.

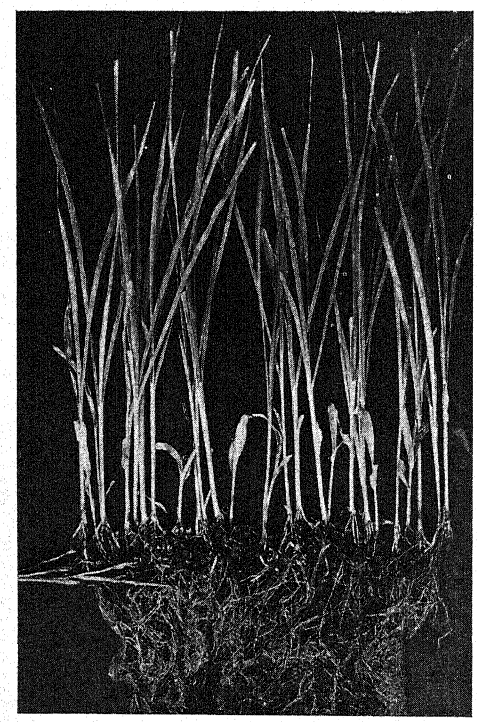
Physics Laboratory,
Baroda College,
Baroda,
September 4, 1939.

[1] *Ind. Jour. Phy.*, 1935, 9, 497.

Lethal Green Seedlings in Sorghum

MANY types of chlorophyll deficiencies have been recorded in sorghum. Albinos are common. Yellow seedlings are rare. Pale green seedlings occur with less frequency, and though in some types they die, in others they survive. In all the above cases the seedlings that are deficient in chlorophyll, being albinotic, yellow or pale green could be easily spotted as lethals by their colour as well as their reduced size. In this note we record the occurrence and inheritance of a type of lethal seedling, which, while it retains its normal green colour, shows considerable reduction in its growth and thus appears abnormal. This type of lethal green seedling, in which a deficiency in the quantity of chlorophyll is not apparent, was met with for the first time at the Millets Breeding Station, Coimbatore, in August 1938, in a pure line of *Sorghum caudatum*, Stapf received from Nigeria. This pure line was being grown for

two years at this Station and did not give such lethal seedlings, nor were such seedlings observed in other pure lines or segregating families. Presumably this occurrence is the result of a heterozygous mutation. In this pure line some



Seeds germinating on an earhead of cholam segregating for normal-tall and lethal green-short seedlings

seedlings, about ten days old were found to be very much stunted in growth and showed signs of dying. They were watched, and when counted, it was found that 187 of the total number died, leaving a surviving population of 609 normal seedlings. Earheads from twelve of these were carried forward and seedlings raised from them. Two came pure and ten of them segregated again giving obviously monogenic segregations, the total of the ten families being 1,374 normal green and 476 lethal green seedlings.

The lethal seedlings can be made out easily from their stunted growth about 4 to 5 days after germination. They show signs of wilting in about a week to ten days, and die when about a month old, when there are 5 to 6 seedling leaves. The first two leaves of the lethal greens do not differ markedly from those of the normal seedlings. The difference in size starts with the third leaf which in the normal is 3 to 4 times longer than that in the lethal. This difference is maintained in the subsequent leaves also. Similarly there is a marked difference in the height of the seedlings, the normals being 4 to 5 times taller than the lethals. The seminal root in both groups of seedlings about 30 days old, is about the same in length. The difference is in the number and size of the adventitious roots which are very few and short or rudimentary in the lethal greens. In some cases the adventitious roots are not developed at all in the lethal green seedlings.

The occurrence of a lethal seedling with no visible chlorophyll deficiency, indicative of its lethal nature, is very interesting. The lethal condition is brought about by an atrophy in the development of both the shoot and the root in the seedlings. The gene responsible for this type of lethal green has been designated cl. CL gives normal green seedlings and is a monogenic dominant to cl.

A photograph of a hybrid head germinated and showing *in situ* both the normal and lethal seedlings, about a month old, graphically demonstrates this phenomenon.

G. N. Rangaswami Ayyangar.
A. Kunhi Koran Nambiar.
Millets Breeding Station,
Coimbatore,
August 25, 1939.

Cleistogamy and Its Inheritance in Sorghum

The occurrence of cleistogamy in sorghum has already been recorded.[1] This phenomenon has been observed in *Sorghum papyrascens*, Stapf (*S. membranaceum*, Chiov.). An examination of all the pure lines belonging to this species grown at the Millets Breeding Station, Coimbatore, shows that all these (which are characterised by very long papery glumes) are generally poor in the extrusion of their anthers. Two of the pure lines were found to be cleistogamic and in them the edges of the lower floral and the upper involucral glumes were found to roll-in, tightly enclosing the upper floral glume and the floral parts. It has also been recorded that the

papery glume in Sorghum (gene py) is a simple recessive to the coriaceous glume of the *Durra* type (gene PY).[2]

In a cross between a coriaceous glumed type and a rolled-in edged papery glumed type, the F_1 was found to be coriaceous glumed with un-rolled edges. In the F_2 (A.S. 4916) a 12 : 4 ratio of coriaceous to papery glume was obtained.

TABLE I

Family No.	Character of Selection	F_3 Behaviour			
		Coraceous Glume		Papery Glu e	
		Un-rolled edges	Rolled -in edges	Un-rolled edges	Rolled-in edges
A.S.5760	Papery rolled-in edges	..	..	..	Pure
A.S.5759	Papery un-rolled edges	..	..	Pure	..
A.S.5758	,,	..	..	Pure	..
A.S.5757	,,	..	..	Pure	..
A.S.5756	,,	..	..	33	11
A.S.5753	Coraiceous un-rolled edges	Pure	..	..	..
A.S.5750	,,	Pure	..	..	..
A.S.5748	,,	Pure	..	..	..
A.S.5747	,,	Pure	..	..	..
A.S.5754	,,	44	..	14	..
A.S.5749	,,	49	..	19	..
A.S.5755	,,	50	..	16	4
A.S.5752	,,	96	..	26	8
A.S.5751	,,	87	..	19	7

In the 4 group, 3 were with un-rolled edges and one with edges rolled in and cleistogamous. The actual figures obtained were 33 : 8 : 3.

A third generation of 14 selections was raised from the F_2 and their behaviour is given in Table I.

The totals of the three triple segregations are as follows:—Coriaceous 233, papery un-rolled edges 61, and papery rolled-in edges (cleistogamous) 19 — ($X^2 = 0{\cdot}12$ $P > {\cdot}90$)—a significant 12 : 3 : 1 ratio.

From Table I it will be seen (1) that cleistogamy is a consequence of the rolling-in of the edges in a papery glume, and its clasp of the contents; (2) that this rolling-in is a heritable character; and (3) that rolling-in manifests only in papery glumes (*py*) and not in coriaceous ones (PY).

A gene designated *gx* is responsible for the rolling-in of the edges of the upper involucral and lower floral glumes in sorghum. The gene could operate only on a papery glume (*py*). The concurrent presence of the genes *py* and *gx* results in cleistogamy.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.
Millets Breeding Station,
Coimbatore,
August 26, 1939.

[1] *Curr. Sci.*, 1936, **4**, 872–73.

[2] *Jour. Ind. Bot. Soc.*, 1936, **15**, 139–42.

A Problem in the Correlation of Pre-Cambrian Granites of Danta State

DANTA STATE in Rajputana had been surveyed by me[1] about a decade back, and it has been re-surveyed recently by Dr. Heron.[2] The fundamental difference in the interpretation of the geology of this State between Dr. Heron and myself is as follows:—

(1) Dr. Heron regards the fine-grained, non-porphyritic, banded, streaky and foliated pink 'granite-gneiss' as sheet intrusions, almost contemporaneous with the coarse-grained, porphyritic, homogeneous and white or cream-coloured 'Erinpura granite'—Post-Delhi in age. On the other hand, I had regarded the 'granite-gneiss' as a Post-Aravalli but Pre-Delhi intrusion, and older than the Erinpura granite.

(2) Dr. Heron regards the metamorphosed calcareous series (consisting of calc-schist, calc-gneiss, crystalline limestone and marble) as Ajabgarhs (the uppermost series of the Delhi System), whereas I had regarded this series as Aravallis.

The above two problems are inter-connected with each other. If we assume that the calc-series belongs to the Delhi System, there is no other alternative left but to regard the granite-gneiss to be a post-Delhi intrusion, and consequently contemporaneous with Erinpura granite, as both the gneiss and the granite show intrusive relations to the calc-series, and there has been no other acid phase of igneous activity after the Delhis and before the intrusion of Erinpura magma. Conversely, if we regard the two intrusions of the granite-gneiss and the Erinpura granite of Danta State to be of two different ages—the granite-gneiss belonging to the phase of the acid igneous activity after the Aravallis and before the Delhis, which has been observed in north-east Rajputana[3] then the calc-series must be regarded as Aravallis and not Delhis.

The granite gneiss forms an almost continuous mass of intrusion in the central portion of the State, extending from north to south. Some of the highest hills and ridges, like 'Sur', 'Dhamanawa', 'Ritaro' and 'Ghori', are made up of this gneiss. This granite-gneiss also extends further northwards along the Danta-Sirohee-Mewar Frontier, where it had been already mapped by Dr. Heron and his colleagues as Erinpura granite, before any of them studied it in its type area (Danta State). Intrusions of typical Erinpura granite are common in this central belt of granite-gneiss, towards its southern margin. The junction of Erinpura granite with the granite-gneiss is quite sharp. For example, at the southern extremity of the Danta State (north-west of Nedardi in the adjoining State of Bhalusana), a small *nala* marks the boundary of the granite (which is here characteristically of Erinpura type) and the granite-gneiss (which is here highly foliated). There is no gradation between the two types at this locality. Further north-eastwards of this locality (near hill 1932, S.E. of Navavas), a big tongue of typical Erinpura granite, from the main mass, cuts across a small ridge of finely foliated granite-gneiss, and there too no gradation is seen between the two types. Dr. Ghosh[4] who had surveyed the Umbri, Bhalusana and other smaller States at the southern boundary of the Danta State, also agreed with me in regarding this granite-gneiss to be definitely older than the Erinpura granite, as he had found the former occurring as inclusions in the latter. Dr. Heron himself regards the Danta State to be the "keystone in the arch" of the geology of Rajputana and northern Bombay.[5] For reasons indicated above, I am still of opinion that the granite-gneiss and the Erinpura granite of this State are not contemporaneous, and they represent two different intrusions. This conclusion will naturally affect very seriously the age of the calcareous series of Danta State and other sedimentaries of the adjoining areas, and ultimately the geological history of this portion of Rajputana.

N. L. SHARMA.

Indian School of Mines,
Dhanbad,
July 20, 1939.

[1] *Q.J.G.M.M. Soc. Ind.*, 1931, **III**, 17–28.
[2] *Rec. G.S.I.*, 1938, **72**, 367–412.
[3] *Mem. G.S.I.*, 1917, **45**, 21.
[4] As cited by—*Rec. G.S.I.*, 1934, **68**, 70.
[5] *Rec. G.S.I.*, 1936, **71**, 69

Pseudomorphs after Leucite in the "Mica-trap" of Jharia Coalfield

WHILE studying the micro-sections of the 'mica-trap' from the Pathardih area of the Jharia Coalfield, I have found that its groundmass is made up of innumerable brownish turbid patches in case of the finer grained variety, and of water-clear patches in case of the coarser-grained one. These patches are strikingly polygonal or subrounded, and equidimensional. They are either isotropic, or are composed of weakly anisotropic material which is orthoclase felspar showing brush extinction, or spherulitic intergrowth of felspar and quartz. Sometimes cryptocrystalline quartz, calcite or limonite also forms a portion of the material of these patches. A few microscopic inclusions of opaque iron ore are observed arranged in the centre. The refractive index of the material forming these equidimensional grains is usually less than that of canada balsam. These patches cannot be originally of opal or of glass, as both the latter are amorphous and cannot show such hypidiomorphic outline. These grains occur in clusters in the groundmass and their refractive index is very low compared to that of apatite needles (present in the same slide), and is even lower

than that of canada balsam. Hence, these grains are not of apatite. The remarkable equidimensional sections of most of these grains and the absence of any longitudinal prismatic section amongst them in the whole slide, show that they were not originally of felspar or quartz, which may have formed by replacing the groundmass or as amygdules in it. It is, therefore, concluded that these crystals must have been of an isometric mineral—probably leucite—which has been replaced or altered by the felspathic material during the late magmatic changes undergone by the rock. These pseudomorphs are illustrated in the accompanying photomicrograph (ordinary light × 60), kindly taken by my friend, Mr. G. C. Chaterji.

N. L. SHARMA.

Indian School of Mines,
Dhanbad,
July 21, 1939.

A Yellow-flowered Variety of *Gynura crepidioides* Bth.

RECENTLY some notes were inserted in this *Journal* concerning the rapid dispersal of *Gynura crepidioides* in Asia. Now I can report the appearance of a yellow-flowered sport in the advancing population.

We received a duplicate of a sheet collected in China, Kwantung Prov., W. T. Tsang 20763, collected at Chong Uen Shan near Kau Fung, Loh Ch'ang district, "Abundant on dry, steep, sandy slopes, in a meadow, weed 1 m. tall, flowers yellow, odorless". The specimen which was not identified was collected before 1932 for Lingnan Herbarium, Canton.

In June Mr. C. N. A. De Voogd, Forest Officer of Buitenzorg Res., collected SW. of Buitenzorg, in the neighbourhood of Djasinga at about 125 m. alt. amidst normally coloured plants, also some plants conspicuous by their golden yellow heads, anthocyane apparently failing. No other distinctive characters against the normal red-brown flowered plants could be found.

I propose to name this yellow sport var. *lutea* nov. var.

In the Netherlands Indies the plant is still spreading eastward and is now also collected in Timor. I expect its appearance in Australia within a few years.

C. G. G. J. VAN STEENIS.

Herbarium, Buitenzorg,
Java,
September 4, 1939.

[1] *Curr. Sci.*, 1938, **7**, 21, 116, 385.

Polyrhachis Ants and Bacterial Symbiosis

WHILE working with the lac insect, *Lakshadia mysorensis* growing on *Shorea talura*, in Bangalore, India, I found the ant, *Polyrhachis rastella* Latr. v. *formicata* Em. intimately associated with it. All the species of Polyrhachis ants I have come across, build their nests underground while the above-mentioned ant lives entirely on trees. I found its nest not only on *Shorea talura* but also on mango and other trees where the leaves were just broad enough to be webbed or rather glued together to serve as small nests for this ant. It seems to have acquired the habit of living on trees in adaptation to an intimate association with scale insects. While surveying the possibilities of spreading itself in a lac plantation, where there was no scarcity of food in the form of honey excreted by the lac insects, I could not imagine why the ant was so scarce there. I never found two nests on the same tree or even a large one so that the greatest search had to be made to discover its nest. What natural factors check this ant from multiplying itself, has never been clear to me.

Polyrhachis formicata is further interesting as secreting a strong odour pleasant to the human nose. While the odour was characteristically allied to amylacetate, traces of a ketone and an amine as well were detectable. An organic chemist kindly suggested the smell might be that of amylformate since most ants produce formic rather than acetic acid. I asked a colleague in the Indian Institute of Science to prepare some amylformate for me which had an unpleasant smell. Many other esters were also tried but the odour of the ant *Polyrhachis formicata* approximated more to amylacetate than to any other ester tried. I also know another ant which produces the odour of ethyl acetate and where no appreciable smell of formic acid is formed so that the generalisation that all ants produce formic acid in some form is not justified.

Polyrachis menelas For. is also found in the lac plantation in Bangalore. It lives underground and as far as the lac cultivating area is concerned it may be looked upon as non-existing by which I mean to emphasise its degree of frequency. This ant emits a weak but appreciable formic acid odour.

Further three allied species of Polyrachis ants, found in Bangalore outside the lac plantation, were examined, each species having an odour characteristic to it and all living underground building very small nests, with about 200 individuals in each nest. All the species of Polyrachis I have studied line their nests with a web, the habit of living on a tree or underground making no difference in this respect.

A bacteriological examination of the intestine revealed the presence of rod-shaped bacteria in the midgut of *Camponotas ligniperda* and *Formica fusca*. I had from time to time also isolated the Bacteria in pure cultures of all these European and Indian ants, so that I was able to see there was no great morphological difference among them. The intestines of many Pentatomid bugs contain long bacteria but these bugs as a class, when compared with all the ants carrying symbiotic bacteria, show a variation, whereas all these ants exhibit a striking uniformity. So far I have examined only five species of Polyrhachis ants and it would be worth while extending such observations to other species. Should this note attract the attention of other workers on ants I shall be most grateful to receive say 5 specimens of each species of *Polyrhachis* ants preserved in 96% alcohol.

S. MAHDIHASSAN.

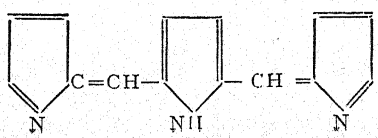
C/o The American Express Co.,
Berlin,
July 30, 1939.

REVIEWS

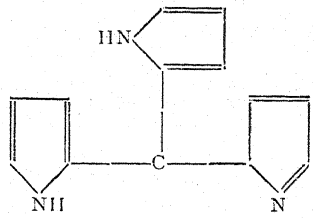
Die Chemie des Pyrrols, Vol. II. Part I (First Half). By Hans Fischer and Hans Orth. (*Akademische Verlagsgesellschaft*, m.b.H. Leipzig), 1937. Pp. xii + 764. Price 44 R.M.

The book has been written by one who has perhaps contributed most to the development of the subject in recent years, and the result is an exhaustive and masterly treatise of invaluable assistance to the specialist. After dealing with the simple pyrrols and their derivatives in the first volume of the series, the authors have devoted their attention in the book under review to the chemistry of the Pyrro-methines containing 2, 3 and 4 pyrrol nuclei respectively, and the colouring ingredients of the blood and the bile. The second half of Volume II has been reserved for a discussion of the chemistry of Chlorophyll and other related bodies such as the Imido-porphyrins which have now acquired considerable interest on account of their relation to the phthalocyanines. Although from the point of view of a systematic study of the pyrrol colouring matters, the division of the book into two such separate halves may not commend itself to many, the authors appear to have been prompted to adopt this method because of the subject of chlorophyll and its relations being at the time in a state of flux.

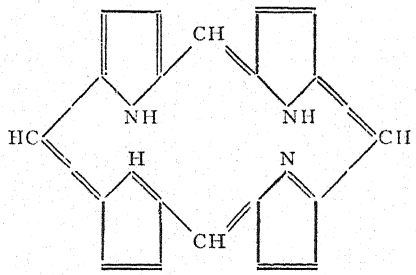
For the convenience of study the book has been divided into three parts. Part A deals with systems containing 2 pyrrol nuclei such as the simple pyrrol-methines and their numerous alkyl homologues and amino-, carboxy-, halogeno-, hydroxy- and other derivatives, and towards the end of the chapter an account of the syntheses of several interesting compounds of the phenyl-, furyl-, and thiophen-pyrryl methane types has also been given. In Part B two classes of what the authors call "trinuclear" products are described, *viz.*, (*a*) Linear Tripyrrenes of the structure,



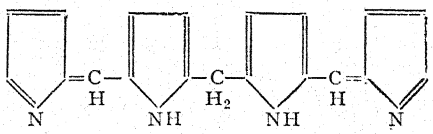
and (*b*) Prodigiosins, the red colouring matters of certain bacteria the molecules of which contain the three pyrrol nuclei bound to one and the same carbon atom, thus:



Part C is by far the most important part of the book. It treats of the tetra-pyrrol ring systems which again have been conveniently subdivided into two groups, *viz.*, (*a*) the Porphyrins in which the four pyrrol nuclei are arranged in the form of a ring,



and (*b*) Bilirubin and its allies in which the arrangement of the four pyrrol rings is a linear one:



The discussion of the chemistry of the Porphyrins covers 460 pages, *i.e.*, a good two-thirds of the volume. An excellent historical introduction to the study of porphyrins is given at the beginning, followed by a complete account of the various methods used in the syntheses of members of this group and a detailed description of the different types, *e.g.*, the Deutero-, Pyrro-, Rhodo-, Phyllo- and Atioporphyrins. The difficult subject of the chemistry of the

colouring matters of blood, Hæmin, Hæmochromogen and Hæmatin, has been treated in a masterly fashion and the various complex salt-formations of the porphyrins and their relations to these colouring matters have been explained very lucidly and skilfully. Under the second subdivision comprising the linear tetra-pyrrol systems, an exhaustive description has been given of the colouring matters of the bile—the "Bilins" and their various transformation products, and also of the synthetic Bilins, the so-called "Bilirubinoids".

The book is a comprehensive and masterly exposition of a complex but extremely fascinating subject and while the specialist would find it indispensable for his work in this field, it would also be most useful to the advanced student and teacher of Organic Chemistry. B. B. D.

Sinn und Aufgaben der Geschichte der Chemie. Dr. Erich Pietsch. (Verlag Chemie, Berlin), 1937. Pp. 33. Price 0·90 R.M.

The author of this short pamphlet of 33 pages urges the great importance and value to the present-day chemist of studying intensively the historical development of his special subject. He firmly believes that the study of chemistry from the historical standpoint is essential not only for a proper appraising of the merit of the chemists' work in initiating new lines of investigation, but most important of all, for understanding and appreciating the trend of human culture and thought in the past. Discussing in a highly philosophic strain what he considers to be the influence of the thoughts and ideas of men like Diderot, Holbach, Lamettrie, Alexander von Humboldt and others on scientific and general intellectual progress, the author has sought to expound his favourite theory that just as the study of history helps man to recognise the forces, direction and achievements of a past period, so the study of the history of chemistry should guide the chemist to the way back to the roots of our existence and thus enable him to become a spiritual participator in the creation of culture. Since chemistry influenced the thoughts of centuries in the past from the times of the alchemists to the present, we should, by occupying ourselves constantly with questions of the history of chemistry, be led inevitably to a truer understanding of the problems of development of the human mind. The author mourns the attitude of the scientists in the modern age, the "age of technique" as he terms it, in concerning themselves only with empirical investigations—an attitude that is mainly responsible for the degrading view that the human being is no better than a machine, and makes an eloquent appeal to chemists to emerge from their vaults of narrow specialisation and study the development of their science in perspective against the background of human culture of past periods. B. B. D.

Recent Advances in Plant Genetics. By F. W. Sansome and Philip. Second Edition. (J. & A. Churchill, Ltd., London), 1939. Pp. xii + 412. Price 18/-.

Since the first edition of this useful text appeared, in 1932, a large amount of work has been published in the field of plant genetics and some previously obscure points have been clarified. The junior author is now engaged in plant breeding in Egypt, wherefore it fell to Dr. Sansome to bring their book up-to-date. The treatment of the subject remains unaltered and the figures are the same except for one or two substitutions.

Chapter II, formerly titled "The Chromosome Theory of Heredity" is now called "Linkage" and has been largely rewritten. This chapter provides a helpful resume of the cytological and genetical basis of such fundamental phenomena as non-disjunction, cross-over values, chiasma formation, segmental interchange and genetic crossing-over. The ten linkage groups of genes in Maize are given alphabetically and chromosome by chromosome, also the smaller linkage groups in *Antirrhunum majus, Lycopersicum esculentum* and *Primula sinensis.* Twelve other species in which linkage groups are known are listed with the author and date. A considerable amount of the recent Drosophila work is used to explain crossing-over and chromosome map-making. There is included a section on the giant salivary gland chromosomes.

Chapter III on "The Constitution of the Gene" has been altered to include the newer work of Eyster, Demerec and Rhoades on multi-allelomorphs and mutable genes, as well as of Stern on somatic crossing-over. There are new sub-sections on mosaicism

in Maize, the size of the gene and the effects of X-rays.

The old section on "Variegation" has been taken from Chapter I and slightly expanded as Chapter IV. It now contains a clear and useful section on Chimæras. In the chapter on Polyploidy the author refers to the recent work on artificially induced somatic doubling by means of colchicine from which horticulturists are expecting great things.

The seven new tables which give the experimental data and theoretical ratios from breeding autotetraploids will be welcomed. Other Mendelian ratios and the statistical basis of selection are not given in this book because they have been adequately treated by others in recent texts. Accounts of the long continuous work in Crepis, Datura, Œnothera and Nicotiana are brought up to date.

Other new contributions in physiological and developmental genetics are touched upon, including incompatibility, colour development, growth hormones and vitamin content. There are no references to the researches on sugarcane and rice genetics being done in India, which are perhaps left to the domain of the sister volume on agricultural plant breeding.

A valuable innovation is a Key to Literature which gives important references, particularly those published since the first edition under appropriate headings. This is omitted from the table of contents. The Bibliography contains 241 new titles, all but 21 of which are published in English. It was noticed that some well-known Continental geneticists are now writing in English.

This book is a necessity for all those engaged in plant breeding and will save teachers and advanced students a lot of trouble in keeping abreast of the expanding frontiers of knowledge in this field.

EILEEN W. ERLANSON.

Principles of Palaeobotany. By William C. Darrah. A new series of Plant Science Books, Vol. III. Edited by Frans Verdoorn. (Published by the Chronica Botanica Company, Leiden, Holland), 1939. Price 7 guilders.

The author's purpose in writing this book has been to prepare a general introductory survey of the field of palæobotany. For this reason much of the controversial matter has been intentionally omitted. The book contains twenty-three chapters, each ending with a bibliography.

In an introductory chapter the author deals with the principles of biology and geology and the relation between botany and palæobotany. The different kinds of fossil plants are classified as petrifactions, incrustations, compressions, impressions and compactions or mummified plants. Of Chapter II, which gives a useful summary of the known methods of investigating fossil plants, about half is devoted to the examination of coal. Chapter XII is devoted entirely to the palæobotany of coal.

After a brief account of the Early Plant Records, many of which are problematica, there follows a series of chapters dealing systematically with the different groups of extinct plants. The classification of vascular plants into four large divisions, Psilopsida, Lycopsida, Sphenopsida and Pteropsida, is commendable for its simplicity and convenience.

Botanists will not easily agree with the author's reasons (p. 105) for the view that the northern Coal Measure flora lived in a temperate climate.

A chapter on the Mesozoic Flora discusses (among other things) the relative antiquity of some modern families of Pteridophyta, and then follows a discussion on the origin of angiosperms. The author strongly inclines to the view that the Cycadeoids were ancestral to the modern flowering plants. Consistently with this idea, which accepts the Magnoliales as being on the line of descent, he regards the woody arborescent habit as the original condition and the herbaceous as the derivative.

In introducing the subject of the mesozoic flora a rapid sketch of the physical conditions is given, laying stress upon the widespread diastrophic movements which must have affected the evolution of plant and animal life. While the date of the Laramide revolution in America may have been late Cretaceous (though even this cannot be regarded as certain), there seems no justification to continue to place the period of vulcanity in the Deccan in the Mesozoic. Recent palæobotanical evidence has now convinced most Indian geologists that the Deccan lavas were poured out in the beginning of the Tertiary era, as was originally believed a century ago, and this view has received much collateral support.

The Cenozoic floras dealt with are mostly American. From these the author leads up to the Pleistocene floras and discusses the physical conditions that have determined the distribution of the modern flora of the globe.

The theoretical chapter on Fossil Plants and Evolution discusses briefly a variety of questions such as the origin of species, the recapitulation theory, migration, adaptation and extinction. In the concluding chapter the author traces the main trends of plant evolution and, in traditional fashion, ends up with a genealogical tree of plant life.

Dr. Darrah has achieved the remarkable task of compacting in a space of 230 pages a mass of facts and theories from the entire field of palæobotany. This has been possible only by restricting the illustrations to the minimum and by making a rigorous selection in the text. The treatment of some aspects is inevitably cursory and a careful reader might find plenty of scope for criticism on individual points. But in a subject that makes such demands upon the imagination in the reconstruction of fragmentary evidence, probably no book is worth writing unless it bears the mark of the author's own views.

B. SAHNI.

Tree Growth. By Daniel T. MacDougal, B.Sc., Ph.D., LL.D. [Published by Chronica Botanica Co., Leiden (Holland) & I.S.S.D. (Macmillan & Co., Calcutta)], 1938. Pp. 240. Price 7 Guilders or about 15*sh.*

This book is the first of a new series of plant science books edited by Frans Verdoorn and published by the Chronica Botanica Co. of Holland.

Innumerable records of measurements of tree growth either as crops or as single individuals have been made for forest management purposes but such records are of little value to the plant physiologist in elucidating the detailed behaviour of trees while they are growing, the way in which the growth in different parts of the tree is correlated and the growth responses to the different environmental influences. From this point of view, a considerable amount of work has been done on the height growth of young trees, but the trouble and difficulty associated with the detailed recording of the diameter increment of stems and especially roots has been responsible for a relative paucity of information on this aspect of tree growth.

Dr. MacDougal has specialised for some twenty years on diameter increment measurements with the aid of various types of dendrometers,—instruments which are attached to the trunks of trees and which magnify the changes in diameter so that they can easily be read, or by dendrographs which record the diameter changes on a calibrated rotating drum of paper. This book collects together the results of a very large number of such measurements made on different species of trees growing under various conditions, and constitutes a valuable and comprehensive addition to our knowledge of the subject. In addition to his own researches, the author refers to previous work done on the subject by others and gives a list of bibliographical references at the end of each chapter. The book thus forms a fairly complete guide to dendrometrical work up to date, and will be of considerable value to research workers contemplating similar work. The book cannot be regarded as a text-book. It is difficult to read with maintained interest as it consists of pages upon pages of detailed description of the trends of diameter increment measurements in different species with brief notes of the particular points they illustrate. In some cases it is difficult to discover whether any particular point is being illustrated or whether the record is of typical or abnormal behaviour. As a book of reference for research workers one would have welcomed a summary at the end of each chapter giving the main conclusions drawn from the dendrographical records described, and the absence of an index makes it difficult for any one to find the information he is seeking without having to search through pages of dendrographical descriptions.

The book is, however, full of interesting information. After an introductory chapter giving a brief history of tree measurement there follows a chapter on methods of measurement in which apparatus for the continuous measurement of increases in both length of shoot and in diameter are described. The types of dendrometer used by the author are also illustrated. Methods of measuring the growth of roots are also mentioned.

The dendrographic record is a wavy line exhibiting daily and seasonal fluctuations that are often considerably greater than the true growth recorded. An interesting account is given of these variations which

have to be taken into account when interpreting the dendrographical records. The variations in size are directly correlated with the water relations inside the tree, as influenced chiefly by transpiration, but also by other meteorological factors. Notes follow on the inception of growth in pines, its relation to air temperature and its dependence upon growth substances produced in the buds. The typical growth cycle of the Monterey pine (*Pinus radiata*) is then illustrated by dendrographic records in its native habitat and correlated with local meteorological conditions and cambium temperatures and is followed by an interesting chapter on the phenology and relationship between radial growth and elongation of the shoots. Much of the author's work was done on the Monterey pine which is peculiarly suited to dendrometric studies on account of its exceedingly rapid growth in both height and diameter. The conversion of leaf products into woody cells is stated to proceed at a higher rate in this species than in any other known tree. Having given detailed accounts of the growth of pines both in their juvenile and adult stages chapters are devoted to the main features of growth of other species, the Sequoias, bald cypress, larches, spruces, Douglas fir and *Cupressus macrocarpa* among the conifers and *Fraxinus, Ulmus, Acer, Platanus* and *Fagus,* the Oaks, *Juglans, Populus,* and *Salix,* among the broad leaved trees with an interesting chapter on specialised trees including the tree-cactus *Carnegiea gigantea,* in which the daily reversible variations are, on account of the behaviour of the stomata in closing in response to increased intensity of sunlight, exactly the opposite to those of leafy trees, expansion taking place in the daytime and contraction at night. Root growth is also discussed in relation to the growth of the above-ground portions of the tree, and the correlation between the area of leaf surface, accumulation of surplus material and the amount of wood formation is described together with an account of some interesting experiments on the effects of artificial defoliation on wood production in conifers.

Space forbids mention of the many interesting physiological facts and theories mentioned in this comprehensive book. They are there if you can find them among the masses of experimental data. One cannot but admire the enormous amount of experimental work that is represented by this book. An account of little more than half a page may represent dendrometrical observations extending over five or even ten years, and some hundreds of such records are referred to.

The researches nearly all deal with growth conditions and species of temperate climates and a number of factors familiar to tropical workers as affecting plant growth are naturally not mentioned. Apart from this slight limitation the book is a valuable addition to our knowledge of the physiology of tree growth.

The printing and general format of the book are good, but considering the price, one would have expected a less flimsy binding.

M. V. LAURIE.

The Chemistry of Milk. By W. L. Davies. (Chapman & Hall, Ltd., London), Second Edition, 1939. Pp. xiv + 534. Price 25*sh.* net.

The early appearance of the Second Edition of the well-known volume on the Chemistry of Milk, three years after the publication of the first edition (reviewed in *Current Science,* 1935–36, 4, 845), is a testimony to the warm appreciation extended to the first edition by the public. The author has utilised the opportunity of issuing the Second Edition for bringing the work up to date. This has necessitated revision and extension of certain portions of the volume. No alteration in the general plan of the book has been introduced.

The subject covered by the volume is one of great importance to everyone interested in human nutrition and for this reason, the book will have a wide appeal. The public analyst, the dairy chemist, the food technologist, the nutrition chemist, the medical man and the public health administrator, will find valuable information and useful data discussed in the volume.

To us in India, the book has a special interest. The appearance of the Second Edition happily synchronises with the author's appointment as the Director of the Imperial Dairy Research Institute in India whose dairy industry is notoriously backward. The wide experience and intimate and expert knowledge which the author has displayed in the volume, will no doubt be utilised in the solution of the intricate problems which confront the dairy industry in this country.

M. S.

Reunion Internationale de Physique-Chemie-Biologie Congress du Palais de la decouverte (Paris Oct. 1937) Chimie Organique. J. B. Bonino-Kurt H. Meyer –L. Ruzicka. (Actualites Scientifiques et Industrielles No. 723) (Hermann & Cie, Paris.) Pp. 55. Price 15*fr*.

This is a pamphlet containing a reprint of three addresses delivered in the Organic Chemistry Section at the Reunion Internationale in October 1937. The opening address is by J. B. Bonino on the Raman Spectra in organic chemistry than which it is difficult to find another experimental method contributed by physics that has proved more fruitful in application to classical organic chemistry. In the study of constitutional problems, study of the aromatic nucleus and heterocyclic compounds, in the identification and estimation of structural isomers, nature of bonds, phenomena of keto-enol, and chelation, Bayer's tension theory, the chemists possess in Raman spectra a new technique which takes them in many cases much farther than many of the older methods which were subject to various errors. The work of the Kohlrausch school, Dupont and Bourguel, Bonino and Manzoni, Krishnamurty and Sreenivasan is referred to.

The second address is by Meyer on the constitution of the crystallographic model and the texture of cellulose followed by a bibliography. Actually one cannot usefully discuss the constitution as during purification, alteration of certain groups in cellulose appears inevitable. Thus the carboxyl group ascertained by Schmidt and Ludtke is usually ignored in the proposed formula. Hess recently claimed that cellulose treated with great care does not contain glucose residue with free hydroxyl at 4th carbon atom. The author refers to Sponsler's work who established the first crystallographic model of the cellulose unit cell as orthorhombic.

The third address is a masterly exposition by L. Ruzicka on the architecture of polyterpenes which have 15–40 carbon atoms none with 25 or 35 carbon atoms being found in nature. The relatively rapid progress in the study of the polyprenes is due to the isoprene hypothesis of Wallach and the dehydrogenation methods. The isoprene hypothesis has been of special assistance in elucidating the structure of many biological products as phytol, squalene, α-carotene, vitamin A, sterins and of polyterpenes found in essential oils and resins. He then referred to resin acids, cadalin, eudalin and schematic cyclisation of farnesol to various sesquiterpenes except caryophyllene. The speaker closed his excellent exposition after referring to many difficulties of work on polyterpenes, procuring the compounds in sufficient quantity being an almost insurmountable obstacle. In the active discussion that followed Dupont and others emphasised the valuable results that may be obtained by application of Raman spectra to synthetic and analytical work on polyterpenes. With small quantities of substances, with complicated molecules in which many lines may be obtained, the examination of the crystals or of a film according to Langmuir is already expected to considerably facilitate the work.

B. SANJIVA RAO.

An Introduction to Chemistry. By John C. Hogg. (Oxford University Press, Bombay), 1938. Pp. 365. Price 8/6.

This elementary text-book stresses the historical approach and gives a cultural setting to an ancient science, which seems to be the object of the writer. Only a limited number of topics have been taken for study but these have been described in detail. The chemistry of metals and many non-metals like members of the halogen family have been completely omitted. Particular emphasis has been laid on the gravimetric aspect and practical details regarding demonstration experiments have been given. The method of writing equations to represent chemical reactions has been well dealt with. This book can be used with advantage by those teachers who lecture to the S.S.L.C. classes and the Junior Intermediate sections of the Indian Universities, since they will only be able to provide the students with the slow and steady growth of knowledge.

M. SESHAIYENGAR.

Chemistry *sans* Dalton

An Introduction to Crystal Chemistry. By R. C. Evans. (The University Press, Cambridge), 1939. Pp. xii + 388. Price 18*sh.*

IN the years immediately following Laue's epoch-making discovery, and the *bahnbrechende* investigations of W. H. and W. L. Bragg in 1914 on the application of X-rays to the study of the structure of solids, interest was chiefly directed to a close study of the structures in themselves. It was not long however before it was realised that the arrangement of the 'bricks' into geometrical patterns in different crystals was governed by general laws and had a wider significance both for the physical and the chemical properties of the substances. The work of V. M. Goldschmidt in 1926 on the morphology of ionic crystals can be truly said to lay the foundation of this modern 'crystal chemistry'. Next in 1929, L. Pauling codified in the form of five rules the general principles underlying the structures of all ionic crystals. Since then steady progress has been made in the subject, and the excellent periodical reviews under the authorship of J. D. Bernal and others, appearing in the *Annual Reports* of The Chemical Society, must be familiar to, at least all chemists.

A connected account of this very promising and highly significant phase of modern physical science, is now made available in the compass of a complete book by Dr. R. C. Evans. R. C. Evans has made the subject doubly interesting by eschewing the drier details while critically appreciating the essential developments, and by wielding a facile pen that goes to make an attractive style of writing. The following excerpts culled from different portions of the book, indicate the fare in store for the reader. "Ideally, crystal chemistry should enable us to predict and synthesise chemical compounds having any desired combination of properties whatsoever." "In solids it is the exception rather than the rule for the molecule to have a discrete existence." "The picture of the sanctity of the molecule has created a quite false impression of the importance of the classical laws of chemistry. The Daltonian laws of constancy of composition and of simple stoichiometric proportions now appear as trivial and insignificant consequences of geometrical requirements rather than as profound and fundamental expressions of the laws of nature. The conception of valency, too, so successful in organic chemistry, has been widely, and sometimes blindly, applied in fields altogether outside its scope, until, on chemical grounds alone, it has become clear that certain classes of compounds refuse resolutely to conform to accepted chemical principles." "It is ultimately of little importance whether a given body is described as a chemical compound or not, provided that its structure is known, and the wider significance of that structure appreciated."

In the first three opening chapters of the book, which constitute Part I, the various types of binding forces that hold together a crystal edifice, namely, the metallic, ionic or polar, homopolar or co-ordinate, and the residual or Van der Wal's are discussed, and their quantitative treatments outlined in their essentials. Finally, there is indicated the scope of Bloch's zone theory for unifying the various *ad hoc* treatments of binding forces, and thus leading to a general theory of the solid state.

All the chemical elements and compounds can be classified, although not rigidly, in terms of the different types of binding forces and therefore indirectly in terms of the crystal structures which they possess. The second part of the book on "Systematic Crystal Chemistry" is based on this classification. The first two chapters on metallic systems, which include lucid accounts of the disorder to order transformations leading to the formation of superlattices, and the Hume-Rothary rules for the formation of 'electron compounds', serve to emphasise the great importance of pattern sites, and the need for a wider conception of chemical combination. After a brief chapter on the limited number of more or less purely homopolar structures, the reader is led on to a series of four chapters on ionic compounds. The concept of 'electro-static valency' as the ratio of the charge on the ion to the number of neighbours co-ordinating it, gives a convenient basis for further classifying the ionic crystals into 'anisodesmic', *i.e.*, those with discrete groups in the structure, 'isodesmic' where no discrete groups occur, and 'mesodesmic' structures in which the strongest

binding has an electrostatic valency strength one half of the charge on the anion. The super-polarising power of the H^+-ion arising from its vanishingly small size, and the consequent anomalous behaviour of compounds containing hydrogen, entitle them to a separate chapter: in this, is also included, a succinct account of the allied topics of the structures of liquids, liquid crystals, and glasses. The descriptions of the various ionic crystals, and in particular the 'defect' structures, with either a statistical distribution of different ions among crystallographically equivalent sites, as in the spinels with 'equipoint' structures, or with incomplete lattices as in Al_2O_3, and Pyrrhotite, leave the classical chemist searching in vain for a trace of his molecule, and thereby disillusioned about the 'sanctity' of the same.

In the last chapter on molecular lattices, where the bonding is generally by residual forces, the concept of the molecule is restored to its true and proper place. Here the shape of the individual molecules plays an important rôle, and the structures can be broadly classified according to the molecular shape, and the type of inter-molecular force, apolar, polar or ionic. The number of such crystals whose structures have been completely worked out is not large, but to the extent progress has been made, significant informations regarding the precise molecular configurations, and intra- and inter-molecular bondings, have been obtained, which are otherwise beyond the scope of direct chemical experimentation. A striking example in this connection is the work of J. M. Robertson on the phthalocyanines, for under the favourable circumstances prevailing in this case, he has achieved the first absolutely direct analysis of an organic molecule, and one which does not involve even the assumption of the presence of atoms. Indeed this analysis goes one step further, and the chemist has to stand corrected regarding the distribution of valencies in the molecule. With other complex molecules even the incomplete X-ray analysis at present possible, is not without profit, as it has frequently enabled important conclusions to be drawn about molecular structure merely from the cell dimensions, and the space group, *e.g.*, the sterols and sugars.

The printing and get-up of the book are excellent: just one print mistake has been detected on page 342, line 21, where 'molecular' has obviously to be corrected to 'molecule'. For original sources a choice selection is given, which includes almost all the summarising articles, wherefrom fuller and complete references can be easily had. The book is moderately priced and must find a place in any science library.

M. A. G. RAU.

Modern Psychology grapples with Man

Introduction to Psychology. By E. G. Boring, H. S. Langfeld, H. P. Weld and Collaborators. (John Wiley & Sons, New York; Chapman & Hall, London), 1939. Pp. 652. Price 15*sh.*

READERS of *Current Science* perhaps know that the three distinguished psychologists, E. G. Boring, H. S. Langfeld and H. P. Weld have already published "Psychology: A Factual Text-Book" with the help of collaborators, and a revised edition of that work now appears under a new title, because, "This new book is so much more than a revision of the old that we have given it a new title" (p. vii, Preface). New chapters, new collaborators, revision and rearrangement of chapters, occasional expansion and condensation of contents of certain chapters should be deemed sufficient justification for the advent of a new book.

Not for these and many other features that may become apparent to those who peruse the volume will it be welcomed. The book commences with a specific question: What is man? The opening chapter is entitled "The Nature of Man". The concluding chapter repeats the title, and has a thick-face type sub-heading or commencement *Da Capo* "as at the end of a passage of music" (p. 627). Without keeping anyone in suspense, the question is almost immediately answered. What is man? "A man", the distinguished authors answer, "is a mass of protoplasm moving about on the face of the earth". What is the chief characteristic of man? His conduct is dominated or right through governed by needs. To satisfy countless needs, he "acts, learns, thinks and perceives". Let the matter be clinched. What is a person? *Needy protoplasm with*

all these properties. (Italics mine.) The authors tell us that modern psychology attempts an outline of man's sketch on the lines indicated. A complete picture of man understood as needy protoplasm is attempted in the course of 18 chapters. There is no need to repeat the contents at any length. Man is a mass of protoplasm. He is thrown amidst an environment. He should adjust himself to it or refashion it to suit his convenience. He has needs. Satisfaction of the needs is the goal of existence. He thinks, learns, and acts in the interests of the satisfaction of the needs.

One must be grateful to the authors for a frank statement of the conclusion of modern psychology on the problem of man without any camouflage. Out of the plenitude of the reviewer's unconcealed gratitude is the title of this notice chosen. I would like frankly to frame the straight question: Has modern psychology ushered in with a flourish of trumpets, propaganda and advertisement after all grappled with the problem of man? *Introduction to Psychology* renders the answer that Man is a mass of needy protoplasm. I am unable to see how this answer is claimed to have been given by "modern psychology". Modern biology may well define man as a mass of protoplasm. Man may further be defined as a bundle of nerves and neurones. It would be impossible to forget the definition of man as a *consolidated colony of cell bodies and chromosomes.* Sex-urge, food-urge, fear, instinct of self-preservation are all shared by animals along with man. Animals are undoubtedly masses of needy protoplasm too. The *reductio ad absurdum* of the view of man upheld by Boring, Langfeld and Weld would be: Hitler is a mass of needy protoplasm securing satisfaction of his needs in his own way! Sir C. V. Raman is a mass, again, of needy protoplasm securing satisfaction of his light-needs in his own way!

I am afraid there is absolutely nothing in the volume under notice for students of Indian Psychology to enthuse over. Behaviour of mankind in different zones of civilization is by no means a rational or scientific guarantee of the correctness of definition that man is a mass of protoplasm. Heredity, and Environment, Matter and Energy are not alone sufficient to explain adequately the facts and phenomena of life. The contention is perfectly understandable that for purposes of verification under the conditions imposed by laboratory investigation and the concomitant qualitative and quantitative analysis, nothing of man is available except his overt behaviour, or adjustment to environment, and that from such behaviour or adjustment his motivation is to be inferred. In receiving and registering sensory stimuli emanating from external Reality and impinging on the organism, and in the execution of correct and efficient responses, neuromuscular, protoplasmic mechanism is the only go. So far one can easily follow the modern psychologists. From this there is an unmistakable *non sequitur* to the view that man is nothing more than protoplasmic stuff or mass of protoplasm. Failure to realize the nature and consequences of this palpable *non sequitur*, deliberate or unconscious or unwitting, is the bane of Modern Psychology of the type presented in the volume before me. According to Indian Psychology, man is first self (*Atman*). In addition to the well-known sensory-motor mechanisms or organs (*Indriya*) there is a specific, special inner sense (*Antah-karana*), which is the *mind.* Psychology would cease to be an independent science if mind is ignored or denied under cover of protoplasm. Psychologists *a la* Othello would lose occupation if man were nothing more than protoplasm. The mind (*Manah*) is differentiated into *Manas, Buddhi, Ahamkara* and *Chitta. Contact of self with mind* is the root-cause of all conduct, emotion and intellect, or of volition, emotion and intellection or cognition. Modern Psychology is a mysterious mixture of Anatomy, Physiology, Biology and Neurology. What then is Psychology proper? The book contains no answer. The distinguished authors, however, have issued an attractive volume.

R. NAGA RAJA SARMA.

INDUSTRIAL SECTION

Chemical Cotton

THE term 'chemical cotton' is used for chemically cleaned cotton, *i.e.*, cotton from which substances other than cellulose have been completely removed. Chemical cotton is nowadays used as a basic raw material for the manufacture of a large number of articles, such as artificial silk, staple fibre, photographic films, transparent paper, plastics, gun cotton and lacquers.

The term 'chemical cotton' is likely to convey the impression that it is made from ordinary staple cotton which is generally used for manufacturing textile goods. This is not the case. In practice cotton linters, *i.e.*, those short fibres which are left on the seed after the ginning operation has removed the longer fibres and which do not possess any worth for textile processing, form the chief raw material of the chemical cotton industry. These fibres, though short in length, possess the same high grade cellulose as the longer fibres. In addition, chemical cotton may also be manufactured from cotton waste, old rags, waste yarn and stained cotton by employing suitable processes of cleaning.

Linters were unknown till about the end of the nineteenth century, when delinting of cotton seed was undertaken in America, primarily with a view to preparing the seed for extraction of oil. Subsequently these linters were found to possess an economic value of their own, and their production increased very rapidly. To-day the annual production of linters in U.S.A. exceeds 1,000,000 bales of 500 lbs. each.

In India the production of linters was practically unknown till about 1935, when the Indian Central Cotton Committee took up the problem. It was found that a number of varieties of Indian cottons delivered, on ginning, seeds which could be delinted subsequently. About this time a few oil mills started delinting the seed to improve their oil production, but the linters obtained were not put to the best possible use. The number of delinting machines installed in oil mills and ginneries has steadily increased and we now produce a few thousand bales of linters annually. In the absence of any cellulose industry in this country, however, these linters have to depend solely on the foreign purchaser, who is somewhat exacting in his specifications. Recently, it was reported that several hundred bales of linters were lying idle for want of purchaser, presumably due to the ungraded quality of these linters and the severe competition from U.S.A. where the industry has been highly organised in the last 15 years.

It is well known that shortly after the last Great War America was obliged to standardise linters on account of the enormous growth and the special importance of this industry. If we wish to utilise our raw materials to the best possible advantage, it is necessary that we should adopt the most up-to-date methods of producing and grading them, so that they compete with the foreign materials. In this respect the steps already taken by the U.S.A. should prove a valuable guide, and while applying them to our peculiar conditions, we should try to improve upon them wherever possible. In view of the importance of this problem, it has been undertaken by the Indian Central Cotton Committee and is at present being worked out at its Technological Laboratory.

It has been estimated that the potential supply of Indian linters which can be reached in the near future, is well over 60,000 bales. This supply can be augmented later if the demand is strong. For securing a steady market at an economical price it would be necessary to standardise this supply. Furthermore, it would be highly desirable that these linters should be cleaned chemically in this country so as to create a new industry which would supply the needs of several chemical and manufacturing industries. The necessity of producing standard types of chemical cotton is even greater than in case of raw linters, as the requirements of the former are more exacting than those of the latter. In view of these reasons an experimental plant for producing chemical cotton has recently been sanctioned by the Indian Central Cotton Committee. It is hoped that this pilot plant will not only prove a forerunner for industrial enterprise for the manufacture of chemical cotton in this country but also for the development of several industries which require chemical cotton as a base.

N. A.

Industrial News and Notes

We wish to invite the attention of our readers to a new feature in the Science News Section, which will provide information relating to technical advances secured in the domain of chemical plant, and constructional materials, industrial machinery and equipment and control devices. In this connection we wish to acknowledge with thanks the ready and courteous co-operation extended by the various research organisations and industrial firms in Great Britain and elsewhere who have willingly placed at our disposal, information relating to their research activities and literature pertaining to their technical products.

CENTENARIES

Duncumb, John (1765–1839)

JOHN DUNCUMB, an amateur British agriculturist, was born at Shere, Surrey, in 1765. Having received his early education at Guildford, he joined the Trinity College, Cambridge, and came out B.A. in 1787 and became an M.A. in 1796. For four years from the date of his graduation, he was editor of *Hereford journal*. In 1791 he entered holy orders and held different benefices from time to time but never changed his residence from Hereford.

His Contributions to Agriculture

Charles, the eleventh Duke of Norfolk, who had extensive estates in Herefordshire engaged Duncumb to write a detailed history of the country on payment of two guineas a week and travelling expenses to tour the country for collecting materials. Two volumes were published till 1815, when the Duke died. The book was completed by others as late as 1882. But the journey for the collection of materials made Duncumb a familiar figure in the county and gave a distinctively agricultural turn to his interests.

He became Secretary to the Herefordshire Agricultural Society from its formation in 1797. He published two books on Agriculture: *Essay on the best means of applying pasture lands, etc., to the production of grain and of recovering them to grass* (1801) and *General view of the agriculture of the county of Herefordshire* (1805). The latter received consideration by the Board of Agriculture and Internal Improvement.

Duncumb died at Hereford September 19, 1839.

Gee, Samuel Jones (1839–1911)

SAMUEL JONES GEE, a British physician, was born in London September 13, 1839. Having received his early education in a private school, he entered the University College, London, in 1857 and became M.D. in 1865. He became a fellow of the Royal College of Physicians in 1870.

His Career

He became house surgeon at the Hospital for Sick Children in Great Ormond Street, London, in 1865 and changed over to the St. Bartholomew's Hospital in 1868, where he remained in various capacities till death. He taught successively morbid anatomy, pathological anatomy and medicine. He was appointed physician to George, Prince of Wales, in 1901.

His Contributions

Gee became one of the authorities of his time on pediatrics. He wrote nearly fifty papers, most of which appeared in the *St. Bartholomew's Hospital reports*. The earliest papers which were on chicken-pox, scarlet fever, and tubercular meningitis, appeared in Reynold's *System of medicine* (1866–68).

Gee published two books: The first *Auscultation and percussion, together with other methods of physical examination of the chest* (1870) attained the dignity of its sixth edition in 1908. It is regarded "at once the most exact and the most literary account of its subject in English". Gee's other book, *Medical lectures and aphorisms* (1902), contained fourteen essays and 272 aphorisms and it reached its third edition in 1907.

Gee delivered three endowed lectures at the Royal College of Physicians: Galstonian lectures (1871) *On the heat of the body;* Bradshaw lectures (1892) *On the signs of acute peritoneal diseases* and Lumbeian lectures (1899) *On the causes and forms of bronchitis and the nature of pulmonary emphyseme and asthma.*

His End

Gee was librarian of the Royal Medical and Chirurgical Society from 1887 to 1899 and had a wide knowledge of books. But he was essentially a lonely man, with no hobby to bring him into familiar contact with his fellow-men. Happy in his domestic life and with his books, he preferred to remain at home when each day's work was done.

Gee died suddenly of heart failure at his daughter's house at Keswick August 3, 1911.

S. R. Ranganathan.

ASTRONOMICAL NOTES

Eclipses.—A total eclipse of the Sun will occur on October 12; but no phase of the eclipse will be visible in this country. The path of totality lies entirely in the Antarctic regions. On October 28, there will be a partial eclipse of the Moon which will also be invisible in India. The magnitude of the partial eclipse will be 0·992 with the Moon's diameter as the unit.

Planets during October 1939.—Both Mercury and Venus will be evening stars and will be low down in the western sky at sunset. Mars can be seen on the Meridian in the early part of the night; it is moving away from the Earth and getting fainter, the stellar magnitude decreasing from $-1\cdot0$ to $-0\cdot4$ during the month. Jupiter will continue to be a bright object favourably situated for observation for the greater part of the night. Likewise will be Saturn, which is in opposition to the Sun on October 22. It will be at its maximum brightness magnitude 0·1 (nearly equal to Vega), about the middle of the month. Uranus is near the western border of Taurus and is slowly moving in a retrograde direction; it can be seen on the meridian about a couple of hours after midnight. On October 29, there will be a close conjunction of the planet with the Moon, the angular distance between the two at the time being a little more than a degree. Neptune is a morning star and with some optical aid, can be located as a faint object lying midway between the two fourth magnitude stars υ Leonis and ν Virginis.

Comets.—An unexpected Comet was discovered by M. Rigollet on July 28, in the constellation Taurus. It was fairly bright (of magnitude 8) at the time, and diffuse with a central condensation but without a tail. According to the orbit computed, the time of perihelion passage appears to have been 1939 August 9. The Comet is receding from the Earth and becoming fainter. Dr. Cunningham suggests that this Comet is probably identical with Comet 1788 II.

Prof. Kaminsky of Tashkent has reported the discovery on July 24 of another new Comet in the constellation Aquila. The object was bright at that time (of the seventh magnitude), and moving rapidly in a south-easterly direction. The number of Comets, discovered so far this year, is nine.

T. P. B.

Magnetic Notes for July, 1939

MAGNETIC CONDITIONS.—The days (G.M.T. midnight to midnight), are classified *quiet*, *slightly* disturbed, *moderately* disturbed, *greatly* disturbed, or *very greatly* disturbed, on the basis of a critical examination of the Declination, Horizontal Force and Vertical Force magnetograms of the Alibag Magnetic Observatory, Bombay. The oscillations in the different elements on a particular day as also the deviation of the day's magnetograms from those of a *selected quiet* day during the month are taken into account in assigning the character for the day in question.

The month of July, 1939, was magnetically more active than the previous month. During the month of July there were 9 *quiet* days, 14 days of *slight* disturbance, and 8 of *moderate* disturbance. There were no days of *great* disturbance. The magnetic conditions during the month were quietest on the 9th and most disturbed on the 4th. The characters of individual days of the month are given below in tabular form.

Dates of the month of July 1939	Quiet days	Disturbed days	
		Slight	Moderate
	6 to 10, 13, 18, 30, 31	1, 2, 12, 15, 16, 17, 19, 22, 23–25 and 27–29	3, 4, 5, 11, 14, 20, 21 and 26

Magnetic Storms.—During July 1939, 5 *moderate* storms each with a prominent 'sudden commencement' in all the three magnetic elements were recorded, as against 3 (2 moderate and 1 great) during the corresponding period last year. The mean character figure for the month was 0·97 according to the international scheme (0 = quiet, 1 = slight disturbance, 2 = larger disturbance) as against 0·52 for July of last year.

M. R. RANGASWAMI.

The Cultivation of Cinchona in India

IT appears probable that we shall soon be having a big development in the cultivation of cinchona in India. Towards the end of the year 1937 it may be recalled that the Imperial Council of Agricultural Research, set on foot an enquiry into the prospects of cinchona cultivation in India and appointed Mr. A. Wilson, Deputy Director, Cinchona, Madras, to conduct the enquiry and also associated with him Dr. T. J. Mirchandani, Agricultural Chemist, Bihar, as Soil Chemist. The Report of these officers which has just been published as Mis. Bulletin No. 29 of the Council, goes fully into the subject, giving an account of the present situation and prospects and an equally interesting survey of the nature and extent of the efforts in the past. It may not be generally known that India is already a fairly large producer of quinine from locally grown cinchona bark and that in the past it was producing much larger quantities. The present annual production is put down as some 70,000 lbs. of quinine; until about the year 1880 she was a much larger producer, the estimated quantity of bark per year at that time being as much as 950,000 lbs. or an output of nearly 2 lakhs of pounds of quinine—facts which amply demonstrate that India has the soil and climate suitable for producing a large quantity of her requirements of the drug. This important factor, *viz.*, India's requirements, is estimated variously; the author estimates it at 6 lakhs of pounds, he also refers to other authorities who estimate it at 12½ lakhs of pounds or over twice the first estimate. This is further complicated by the fact that in reality India is consuming only 210,000 lbs. per year or only a third of the lesser of the above two estimates. An account is also given of the difficulties which the Government met with in disposing of their stocks; consumption fell from 80,000 to 60,000 lbs. even though prices became cheaper by 30 per cent. and the demand could not be increased even when the stock was offered for sale at a big sacrifice in price. Altogether we cannot help thinking that this matter of the quantity which India will absorb is decidedly obscure and needs to be clarified. We wish also that a statement had been furnished to show the consumption per year for a period of, say, the last 10 or 15 years. Anyhow the report takes 210,000 lbs. of quinine as the annual requirement; of this quantity local production supplies at present 70,000 lbs. and the remainder is imported. The immediate objective therefore is to grow enough cinchona in the country to produce this 140,000 lbs. of quinine that is now imported. The report further envisages the need for producing the much larger quantities referred to above and contains suggestions to that end also.

Land considered promising for cinchona cultivation in many parts of India, notably the planting districts of South India, Assam, Bengal and Orissa, and the Andaman Islands have been surveyed, soil analyses and profile studies made, and the requirements in this regard discussed. Altogether an area of some 38,000 acres have been specified as suitable and additional tracts are indicated for further similar inspection, if a much larger production should be contemplated, though for the planting programme of twelve years at the rate of 3,333 acres annually stated as required for the latter larger production, this 38,000 acres appear sufficient. Government, planters and small holders are all suggested as suitable agencies for the growing of the plants. We may point out in this connection that no information to show what money return can be expected from the cultivation of cinchona is available in the report although this is an all-important factor, at least as far as the private planter is concerned whether large or small. The cost of production is however given in detail; a statement of the prices paid for bark, or the unit prices that have ruled for the last ten years or so will have greatly added to the usefulness of the report. We should also like that analyses had been given of the soils of certain Anaimalai estates where bark with a high quinine content of 11% was being produced, and likewise of the soils of the Tavoy plantations which are stated to have been a disastrous failure although the area was selected by one of the greatest experts in cinchona.

The species *ledgeriana* is the one recommended to be grown. It is gratifying to learn that 72% of the cinchona grown in India at present is *ledgeriana*, and that among these some extraordinarily good areas may be seen. The need for research is emphasised on the famous Java model and a strong plea put in for a research station for isolating better performing strains of *ledgeriana*, for their multiplication as plants on their own roots or grafted on to *succirubra* stocks, for much nursery technique and so on. Such a station is in our opinion long overdue.

Much has been accomplished even as the result of grafting the *ledgeriana* on to the less-exacting *succirubra* in Java, a comparatively easier line of work which we are told is being done with great facility by ordinary coolies trained for the work, at the rate of some 300 to 500 grafts per day for a set of two coolies; it should be possible to undertake this work at least straightaway on the present Government plantations themselves. It is stated that this was attempted but was not persisted in. The point is further stressed that unless this better species and better yielding types among it are grown it will not be possible to reduce the cost of production. This cost of production will probably be the rock on which schemes of expansion and continuance will split; motives of self-sufficiency are not likely to stand the strain of the ever-present and insistent claims for economy, especially if large supplies of cheaper quinine should be available from Java or other foreign sources. The lines of expansion indicated in the report are cautious and sound; we hope suitable action will soon be taken to give effect to the recommendations.

A. K. Y.

SCIENCE NOTES AND NEWS

Prof. Sir S. Radhakrishnan.—At the request of Pandit Madan Mohan Malaviya, Prof. Sir S. Radhakrishnan has agreed to accept the Vice-Chancellorship of the Benares Hindu University. Sir Radhakrishnan occupies a unique position in the academic world. He is the Spalding Professor for life of Eastern Religion and Ethics at Oxford. He is also the George V Professor of Philosophy and President of the Post-Graduate Council in Art in the University of Calcutta. He is a distinguished member of the International Committee on Intellectual Co-operation at Geneva. He was the Vice-Chancellor of the Andhra University for a period of five years. Recently he has been elected a member of the British Academy, being the first Indian to be honoured by that body.

"For the past ten years, Sir Radhakrishnan has been unweary in the service of the Motherland. He has interpreted the culture of India to the east and the west as few scholars have done so far. As a Lecturer on Comparative Religion at Chittagong and as Hibbert Lecturer in London, Sir Radhakrishnan has been an unrivalled exponent of Indian thought and culture. It is the good fortune of the Benares Hindu University that it has been able to secure the services of this savant."

The appointment of Sir Radhakrishnan will give satisfaction to all those who are interested in the progress of this all-India institution. The Benares Hindu University, which was founded in 1916 as the first residential and teaching university in India, has made remarkably rapid development.

* * *

Excavations at Sopara.—Excavations carried out at Sopara, Bombay, early this year by the Archæological Survey of India, have brought to light the remains of a complete brick built Buddhist stupa of the second century A.D. with its drum, 275 feet in circumference and 4′ 2″ in height, as well as substantial remains of the dome of the stupa now rising 19 feet above the six feet wide terrace around it. Although from the base of the drum, the apex of the surviving dome stands to a height of 23 feet, there is no doubt that originally the stupa must have stood about 100 feet high.

Fortunately, the drum of the stupa survives in its entirety and from its circumference of 275 feet, it may be said to be among the largest of its kind yet discovered in Western India.

Excavation of the open area directly to the south and south-west of the base of the stupa drum has revealed several brick platforms roughly square in plan, side by side with circular brick basements. It is not improbable that these structures attributable to the fourth and fifth centuries A.D. represent the remains of smaller votive stupas, usually dedicated by devotees visiting the main stupa.

* * *

Isolation of Xanthyletin from *Luvunga Scandens* Ham.—The fruit of the plant called Kalka in Bengal has been examined by Spath, E., Bose, P. K., Dobrovolny, E., and Mookherji, A. (*Ber.*, 1939, 72, 1450). They obtained xanthotoxin luvangetin and a mixture of cumarins from which xanthyletin (m.p. 131–131°·5) has been isolated identical with that which Bell and Robertson found in *Xanthoxylum Americanum* (*J.C.S.*, 1936, 1828) also belonging to the Rutaceæ family.

* * *

***Stevia Rebaudiana* Hemsl.** (*Syn. Eupatorium Rebaudianum*,—a small herbaceous plant of the composite family, a native of Paraguay, is assuming importance in view of the presence in its leaves of 6·2–6·5 per cent. of stevioside, a glucoside of the formula $C_{38}H_{60}O_{18}$. Its sweetening power is 300 times that of saccharose. On hydrolysis by acid or the enzyme present in the juice of *Helix Pomatia*, it yields steviol, $C_{20}H_{30}O_3$, and glucose. Emollient properties have been attributed to the glucoside; in any case, it is not toxic even if taken in strong doses. Stevioside is commonly employed in South America for sweetening drinks and bitter infusions. It can be extracted from the leaves of the *S. Rebaudiana*, with a mixture of ethyl and methyl alcohols (85 : 15) at a temperature of 60° C.

The plant grows wild in the great grasslands and especially in marshy areas of Paraguay. In view of the possible industrial application of stevioside, particularly in food preservation, the plant is likely to assume great economic importance in the near future.

* * *

The Use of Beryllium Chloride in Organic Chemical Reactions.—A summary of interesting work carried on by H. Bredereck, G. Lehmann, E. Fritzche and C. Schoenfeld at Leipzig and details of which will be published shortly in the *Berichte* is contained in the *Deutsche Bergwerks Zeitung* (No. 162, July 1939). It has been found that beryllium chloride can successfully replace anhydrous aluminium chloride in Friedel-Krafts reactions and in the synthesis of ketones, as also in condensation, polymerisation and "Cracking" reactions. In every case, however, a higher temperature than with aluminium chloride is found necessary. Typical yields were 6% diphenyl methane (benzyl chloride and benzene), 33% acetophenone (acetyl chloride and benzene), 27% mesityl oxide and 17% phorone (acetone), while the "Cracking" of anthracene and phenanthrene in the presence of beryllium chloride yielded up to 15% of liquid products. The "Cracking" of coal tar was not so successful.

EMMENNAR.

* * *

A New Wood Preservative.—An American Patent (Am. P. 2,149,284) by A. Gordon, Berkely, Cal., U.S.A., describes the composition of a new wood preservative. According to the details contained in the *Deutsche Bergwerks Zeitung* (No. 178, Aug. 1939), 63·2 kg. of copper sulphate crystals ($CuSO_4 . 5H_2O$) are

dissolved in 200 kg. of water; the copper is precipitated by the addition of caustic alkali obtained by dissolving 20·224 kg. of sodium hydroxide in 50 kg. of water. The precipitate is dissolved in an ammoniacal solution (17·75 kg. of ammonia in 1000 kg. of water) and to this solution of cupric ammonium hydroxide is added 21·2 kg. of "arsenic" (presumably the pentoxide) and 0·6 kg. of ferric acetate. The preservative thus obtained can be diluted with (up to) three parts of water. It is claimed that wood impregnated with a solution of this composition would retain the copper and arsenic in insoluble (and therefore unleachable) forms and thus remain immune to the action of wood-destroying organisms. EMMENNAR.

* * *

Pigments in Living Human Skin.—Employing spectro-photometrical methods E. A. Edwards and S. Q. Duntley (*Amer. Journ. Anat.*, 65, No. 1, p. 1) have determined the pigments and colour of the human skin. Five pigments and one additional optical effect are responsible for the human skin colour. They are melanin, melanoid, carotene and reduced and oxyhæmoglobin. The melanin is found in the deeper layers of the epidermis; melanoid which has been discovered for the first time by the authors in the human skin is allied to melanin and is found throughout the epidermis. Carotene is found both in the epidermis and in the dermis. The hæmoglobin is found in the vessels of the dermis and subcutaneous tissue. All these pigments absorb rather heavily in the blue end of the spectrum and are therefore red to the eye and the only reason why human skin does not look red is because of the overlying turbid stratum corneum. The turbid epidermis, on account of a scattering of light raises the blue end of the spectrum over what it would otherwise be if the epidermis were transparent. The glands of the skin and their secretions have no effect on the colour of the skin. Females differ from males in possessing more carotene in their skin but less melanin and blood. The difference between the coloured and white races of humans rests only in the amount of melanin present. Pigments not found in white races are not encountered in coloured races and the general plan of distribution of the pigments is identical in the two races.

* * *

Spermatogenesis in *Schizocosa crassipes* (A lycosid spider).—A detailed account of the behaviour of the chromosomes in meiosis is given by W. L. Hard (*J. Morph.*, 65, No. 1, p. 121). The diploid number of chromosomes in *Schizocosa crassipes* is 22, of which 20 are autosomes and two are univalent accessory chromosomes. The spermatogonial divisions are two in number. During prophase of meiosis a presynaptic split is visible in the leptotene threads. A centromere also is visible. The distinct separation of the homologues all through prophase makes detailed examination of the chromosomes possible. The presynaptic split which is observed during synapsis reappears during diakinesis. The first division segregates the chromosomes. An interkinesis follows it and the second division is simple and equational.

* * *

Locusts in India and Their Control.—It is rather unfortunate that until recently the control of the locust pest in India did not receive that amount of attention by way of research which it deserves. Locusts are associated with destruction, and devastation on a colossal scale and have led in the past even to the depopulation and decay of whole countries. Like the allied visitations of famines and epidemics these outbreaks cease to receive any sustained study or other practical action once they are completely over or remain in comparative quiescence. It is therefore gratifying that its study on a systematic basis and as an important long range investigation should have been undertaken by the Imperial Council of Agricultural Research and that it should be receiving continuous attention. During the last few years that the studies have been in progress a mass of valuable data from both the scientific and practical points of view has been collected and it was a happy idea that a resume suitable for the use of practical farmers should be published (Y. Ramachandra Rao, *Agr. & Live-Stock in Ind.*, 9, Pt. III). What locusts are, how they are related to and can be distinguished from the other members of the grasshopper class to which they belong, the locust proper—the so-called desert locust—which causes the devastation connected with its name, the nature of the infestations, its cycles, seasons and areas of infestation, breeding grounds, the direction of flight of the migratory swarms, the solitary or quiet phase of the incidence, the relation of weather conditions to outbreaks and as a guide to the forecast of possible outbreaks, the various aspects of the control problem and its methods —are dealt with in all their essential features in a manner admirably suited to a popular account. The outstanding element of the problem is that of its being linked up closely with conditions not only in the desert tracts of India and its mountainous north-western frontier, but countries far afield outside of India. Thus the main centres of incipient outbreaks are located in the hinterland of British and Iranian Mekran, and a method of attacking the control problem at its very root will be to arrange for an organisation to keep a close watch in these areas and deal with the incipient swarms as they arise and thus prevent them from reaching their summer breeding areas in India. The winter rainfall areas of Baluchistan are said to be the danger points as regards locust infestation in north-west India and control work here will similarly attack the problem at its root as regards this part of India. In fact, the studies reveal the all-important need of an all-the-year-round work for a permanent organisation irrespective of whether there is an outbreak or not in India, more or less in the nature of an insurance against the pest outbreak.

The methods of combating the pest once it has appeared are reviewed, and many of these have been either suggested or tried at various times. The salient points in the life-history are described so as to indicate vulnerable features which can be suitably exploited, and control methods suited to the different stages in the life of the pest are discussed. Fighting

the adult swarms with the help of aeroplanes was found successful in Rhodesia but the author doubts if it can suit Indian conditions. In view, however, of the many-sided progress in flying craft in recent years we should think that it cannot be beyond the talent of inventors to adapt the method to this purpose. Dealing with egg-masses, the control of hoppers by means of trenches, poison baits of different kinds and so on are described, some of the latter being found very efficient.

There is a gloomy forecast of a definite danger of a new outbreak of the Desert Locust in the near future to which the author draws attention; let us hope, the results of these studies will be suitably made use of against such an outbreak on the principle of 'to be forewarned is to be forearmed'. A. K. Y.

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Ozone Concentration in Stratosphere.—According to a Communique issued by the National Geographic Society, Washington, D.C., three recent flights into the stratosphere over Beltsville, Maryland, by means of groups of rubber sounding balloons reached heights of 14 to 16½ miles above the earth. The balloons, sent up as a joint project by the **National Geographic Society** and the **National Bureau of Standards**, carried on each flight as an "observer" an ingenious robot consisting of electric batteries, a tiny motor, photo-electric cells, moving screens, and radio tubes.

The object of the flights was to gather additional information about the atmosphere's ozone layer—an important concentration of the gas which screens away from the earth's surface certain rays of sunlight injurious to vegetable and animal life. The metal and glass robot made "readings" of the varying concentrations of ozone at different altitudes and automatically radioed them to a receiving station on the ground. The results are being compared with other observations for a later report by the **National Bureau of Standards.**

On each of the three flights the lifting power was furnished by six rubber, hydrogen-filled balloons attached in tandem. Four-and-a-half feet in diameter when they were released, these balloons expanded to diameters of 14 feet or more in the rare upper air near the top of the ascents.

The string of balloons continued to rise until one of them burst as a result of expansion. The remaining balloons lowered the observing apparatus slowly to the ground and in every case it was recovered. The flights were made under the supervision of Dr. Lyman J. Briggs, Director of the **National Bureau of Standards**, and Dr. W. W. Coblentz, Chief of Radiometry, at the Bureau.

In the hope of reaching greater altitudes for the co-operative study of ozone concentrations, the **National Geographic Society** is now having large rubber balloons fabricated. In the mean time improved instruments for detecting ozone and for radioing information back to earth are under construction in the laboratories of the **National Bureau of Standards.**

* * *

Aurora Borealis.—The unusual display of the aurora borealis on the night of August 11, visible over the northern portion of the United States and Canada, was scientifically clocked, photographed and measured more completely than any other auroral display that has occurred in many years. Scientific observers pronounced it the most brilliant and extensive aurora of 1939 and one of the most striking in the past ten years, says a press communique from the **National Geographic Society.**

A three-year study of auroras is being made as a joint research project by the **National Geographic Society** and **Cornell University**, and has been in progress for nearly a year with observation stations set up at Ithaca, Hamilton and Geneva, N.Y. The stations are connected by direct telephone wires, and during the exceedingly brilliant display of August 11, made numerous photographs simultaneously. Comparison of these exposures made many miles apart will make it possible to estimate with considerable accuracy the heights above the earth of the various features of the display.

Dr. G. W. Gartlein of the Physics Department of Cornell University in charge of the co-operative studies, reported that at Ithaca the illumination from the aurora was almost like full moonlight and that automobiles were driven without headlights. He stated that the stations obtained more than 150 photographs, a score of them in natural colour, and 500 exposures with a motion picture camera. He also made a number of spectrograms and was successful in obtaining an automatic photo-electric record of brightness of the later portion of the display.

* * *

Indian Drugs for Treatment of Cattle.—The Imperial Council of Agricultural Research has sanctioned three schemes, at a cost of over a lakh of rupees, for research in Indian drugs to be used in the treatment of cattle. The schemes will cover investigations into the cultivation of medicinal plants, the efficacy of indigenous drugs and the indigenous treatment of cattle.

Lt.-Col. R. N. Chopra, of the School of Tropical Medicine, Calcutta, has been granted Rs. 62,860 for a five years' scheme. The researches under this scheme cover the survey of medicinal plants which can be grown in India, chemical analysis of their pharmacological and therapeutic action and an investigation of food poisons, particularly in cereals.

The second scheme which will be a study of poisonous plants and of their doses required in veterinary practice, will be controlled by the Surgeon-General of Madras. This will be a three years' scheme and will cost Rs. 39,000. The object of the scheme is to examine how far indigenous drugs can take the place of the imported ones.

The third scheme sponsored by the Premier of Orissa, is for the collection of literature about cattle treatment by indigenous drugs. It has been sanctioned initially for a period of six months at a cost of Rs. 4,500. Information from manuscripts and other sources is being collected and collated.

As two of these three schemes are veterinary, they will be correlated to the comprehensive survey of cattle diseases already being

made by the Imperial Veterinary Research Institute, Mukteswar, through the Veterinary Investigation Officers.

* * *

Cardamom Beetle (*Thamnurgides cardomomi* Schauff), which is regarded as a serious pest of cardamoms in Coorg, Mysore and Madras, breeds actually in the fruits of several forest trees, and attacks cardamoms *only* when in unusual abundance. It does not breed in the dried, stored cardamoms but bores into green fallen cardamom fruits in malés located in broods. The pest is not responsible for the failure of the crop in Coorg as has been erroneously assumed.

Damage to the crop can be prevented by not growing cardamoms in the vicinity of these dangerous trees or by keeping the ground clean of their fallen fruits.

A recent survey made to discover the alternate food plants of the borer resulted in the discovery of 17 new species of *Thamnurgides* and 5 of *Coccotrypes* (*Ind. Forest Records*, 1939, 5, 279).

* * *

Calopepla leayana **Latr.**—A plantation of *Gmelina arborea* intended for pitwood was destroyed by an insect pest at Namtu in the Northern Shan States, Burma. The loss is estimated at Rs. 4,50,000. Mainly owing to the damage done by the beetle, a block of 1,600 acres was abandoned in 1934 and another of 1,400 acres in 1936.

The insect *Calopepla leayana* Latr. has been causing extensive damage to this tree in Assam, Bengal, Madras, the United Provinces, and Burma and is found from 500 feet above sea-level in the foothills rising out of the Irrawady plains to about 8,000 feet above sea-level at Darjeeling.

Not only leaves but buds and young growing shoots are chewed, and two consecutive years of the attack kill the trees.

Methods of control used by the Forest Entomologist in Burma are discussed in an issue of the *Indian Forest Records* (New Series) entitled "Biology of *Calopepla leayana* Latr. and the Possibilities of Control", just published from the Forest Research Institute and College, Dehra Dun.

The natural enemies of the beetle include a predaceous bug (*Canthecona furcellata*), a Chalcid egg parasite (*Tetracampe* sp.) and a pupal parasite (*Brachymeria* sp.).

* * *

Variations in Rainfall.—A new method of analysis based on the μ test suggested by Dr. S. R. Savur in which the median is used in place of the arithmetic mean, has been adopted by Mr. L. S. Mahalingam in studying the variation of rainfall in India (*India Meteorological Department Scientific Notes*, No. 82). The main conclusions obtained from the analysis are:—The rainfall associated with thunderstorms in the hot weather months, March to May, is differentiated from the rainfall of the monsoon months in almost all stations. During the monsoon months rainfall in July is greater than in June except in Burma and parts of northeast India. Rainfall in July is not significantly different from that in August except in the western parts of the Peninsula. September shows generally a distinct decrease from August, except in the southern and eastern parts of the Peninsula.

* * *

Large-scale City Surveys.—The value of large-scale city surveys for settlement and town planning purposes is being increasingly recognised in India. A survey of Lahore is now in progress and numerous experimental measures have been adopted for the survey and should they prove successful there is little doubt that other municipalities will follow the lead of Lahore. A large-scale survey has already been commenced at Murree. According to a press note issued from Simla, the Lahore survey is being made on the scale of 40 feet to one inch in the congested areas and 100 feet to one inch in the open areas. The work is being carried out under the control of the Director, Frontier Circle, Survey of India.

"The work presents many problems from the technical point of view, not the least of which are the transference of accurate positions from the tops of houses, where the triangulation had to be carried out, to the ground; and the control of traffic so as to prevent disturbance to delicate instruments or obstruction to view, during the course of observations.

"To expedite the fixing of details which forms the major part of the work and to ensure its accuracy, a new type of 'offsetting instrument' and new plotting scales have been devised several of which have been manufactured by the Mathematical Instrument Office of the Survey of India and put into use with satisfactory results.

"The use of these special instruments and the experience gained in Lahore, it is hoped, will bring the cost of these highly accurate surveys which had hitherto been regarded more or less as a luxury within the means of the major cities and towns of India."

* * *

The King Crab.—At the ordinary monthly meeting of the Royal Asiatic Society of Bengal held on Monday, the 4th September, Dr. H. S. Rao of the Zoological Survey of India exhibited a king crab. "The king crab is a curious marine creature which has lived through millions of years up to the present time practically unchanged in its general morphological features. Its closest allies are probably among the scorpions and prawn-like crustaceans, but may not be classed with the groups to which these belong. It has a wide distribution along the Indo-Malayan, Chinese and Japanese coasts and along the East coast of North and Central America. There are two species of King Crabs which inhabit the East coast of India. One is essentially marine and lives on a sandy or muddy bottom up to a depth of twenty fathoms while the other is mainly estuarine ascending the River Hughli as far as Calcutta. In the breeding period of the marine species which corresponds to the close of the cold weather in Bengal and Orissa, king crab may be seen in pairs, the male—which is smaller in size than the female—has the second and third pairs of limbs of the front part of the body modified

as a clasper holding firmly on to the shield-like back of the female."

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The Annual Report of the **Health Organisation of the League of Nations** has been included in the latest issue of the *Bulletin of the Health Organisation* of the League (Vol. 8, Nos. 1–2).

Prevention and treatment of malaria, cancer, leprosy, bilharziasis and rabies; medico-social action in the sphere of rural hygiene, nutrition, housing and physical education; epidemiology and health statistics; biological standardisation; campaign against narcotic drugs; unification of pharmacopœiæ and anti-epidemic action in China—these are the sub-heads of the report. The wide field comprehended by the League of Nations in its work of international co-operation and in its efforts to raise the standard of health, will become manifest by a perusal of this report.

The *Bulletin* also includes (1) an article entitled "Health Indices", which is a skeleton standard report for use in surveys of the state of health and vitality of a given population, (2) the report by M. Vignerot (France) on "Rural Housing and Planning", and lastly, (3) an article on "Leptospiroses" by Dr. Walch-Sorgdrager.

* * *

The Government of Mysore have notified that with effect from October 1, 1939, in the Bangalore and Tumkur Districts, including the City of Bangalore, no petrol shall until further orders be sold or kept for sale except with an admixture of alcohol manufactured in the Distillery established by the Mysore Sugar Company, Ltd., at Mandya. The proportion of petrol and alcohol in the mixture shall be 85:15 by volume.

Mysore has been the first to pass such a legislation. Several Provincial Governments in British India are adopting legislation of this nature.

* * *

The inauguration of the St. Xavier's College (Bombay) **Natural Science Association** took place on the 25th of last month when Lt.-Col. Bhatia addressed the assembly. The Association was founded during the year by a band of enthusiastic students who have secured the support of the Principal. The Association aims to subscribe for as many specialised scientific periodicals as possible, to arrange for lectures and discussions, and to promote the development of Natural Sciences.

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We have pleasure in announcing that **Dr. W. L. Davies**, Director of Dairy Research, Simla, has accepted our invitation to join the Board of Editorial Co-operation.

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University of Mysore.—(1) *Admissions during* 1939–40: The student strength of the University during 1939–40 including the Medical School and the School of Engineering, Bangalore, was 3,601 as against 2,891 during 1938–39.

(2) *Physical Education and Military Training*: Physical Education has been made compulsory in the men's colleges in the University with effect from the Junior Intermediate class of the current year. Facilities for the Military Training of a hundred students in each centre have been provided from this year.

(3) *Women's College*: The degree classes of the Maharani's College for Women in Mysore were transferred to Bangalore and a Science section was introduced in the Maharani's Intermediate College at Mysore.

(4) *Examinations*: The results of the M.A., M.Sc., and Final M.B.B.S. examinations were published. They were as follows:—

Name of Examination	*No. Examined*	*Passed*	
		I Class	*II Class*
M.A.	11	7	3
M.Sc.	12	4	7
M.B.B.S. (Part I) ..	7	..	6
,, (Part II) ..	12	..	7

(5) *Convocation*: The 22nd Annual Convocation of this University will be held at Mysore on Wednesday, the 25th October 1939. Sir Nripendranath Sircar, retired Law Member, Government of India, has kindly consented to deliver the Convocation Address.

(6) *Fellowship*: A scheme of fellowships tenable for three years each has been sanctioned in place of the scheme of post-graduate research scholarships tenable for a year each.

(7) *Deputations*: Messrs. C. K. Sundarachar and L. Narayana Rao have been deputed for advanced studies in Physics and Botany respectively and Mr. P. H. Nagappa for Actuarial Science.

* * *

University of Bombay.—The degree of Ph.D. in Botany has been conferred on **Mr. T. S. Mahabale, B.A., M.Sc.**, of the Gujarat College, Ahmedabad, in consideration of his thesis on the genus *Ophioglossum* in India. Mr. Mahabale's work is comprehensive and has been highly spoken of by the examiners. He is the first Ph.D. in Botany of the Bombay University.

Industrial Notes

Vitreosil.—*Messrs. The Thermal Syndicate, Ltd.*, London, have sent us an illustrated brochure, which contains valuable information regarding Vitreosil or pure fused quartz and silica, which possesses "remarkable properties of great value for scientific and technical purposes". It is well known that in many laboratory operations, especially those where heat or acids are involved, Vitreosil has almost replaced, not only platinum and other costly materials but also porcelain.

The Thermal Syndicate which pioneered the production of comparatively small pieces of laboratory ware from fused quartz are now in a position to fabricate large chemical and other plants as regular items of manufacture. They have extended their activities to the production

of cooking ware, the requirements of the electrical and gas industries and the medical profession. They have not ignored the possibility of utilising the artistic and decorative efforts presented by the remarkable rippled silver-like appearance assumed by certain forms of fused silica.

Both translucent and transparent varieties of Vitreosil are manufactured; the transparent kind has proved invaluable in connection with radio therapeutic mono-chromatic and ultra-violet light apparatus. Highest qualities of their transparent material are available for lenses, prisms and other optical purposes.

The brochure contains a detailed account and data of the mechanical, chemical, thermal, optical and electrical properties of vitreosil, gives a few of the numerous applications of the various sizes and shapes manufactured by the Syndicate and includes an extensive bibliography of 205 references to scientific literature.

Centrifugals.—Centrifugal separations constitute one of the fundamental unit processes in chemical engineering practice. Different types of centrifugals, to meet varying requirements of industry are now on the market, among which the Broadbent centrifugals enjoy a world-reputation for efficiency and relativity. These centrifugals are backed up by seventy years' experience which *Messrs. Thomas Broadbent & Sons* have acquired in the fabrication of these machines. Every possible improvement incorporating all the very latest developments in engineering and metallurgical practice is embodied in their design and manufacture. The seventy-six page illustrated pamphlet issued by this enterprising firm, gives an idea of the wide variety of centrifugals and hydroextractors fabricated by them. Those interested in these machines should get into touch with Messrs. Thomas Broadbent & Sons, Ltd., Huddersfield, England, who will be pleased to furnish further information and data.

According to a notification issued by the Research Department of the **Instiute of Automobile Engineers**, two new items of research have recently been added to the programme of work being carried out by the Automobile Research Committee. One of these items relates to the effect of radio interference suppressors on engine performance: in this connection, there is a possibility that the fitting of interference suppressors in the spark-plug high tension leads may have to be enforced on all cars in order to avoid interference with short-wave wireless reception, particularly television. It is therefore important to ascertain whether these suppressors have any adverse effects on engine performance, and experiments are now being carried out at the Brentford Laboratories on single- and multi-cylinder engines, a cathode ray indicator being used to study the effect of suppressors on ignition and combustion.

The other new item of research relates to the over-heating of brake drums and wheel rims on commercial vehicles. Under modern conditions, the transfer of heat from brake drums to the wheel rims is sometimes excessive, resulting in a serious shortening of tyre life. A back axle, complete with wheels and brake drums, is being used for a laboratory study of heat dissipation from the brake drums, and various methods of insulation and ventilation are being tried.

Mysore Timbers.—The Forest Research Section of the Forest Department of the Government of Mysore, has issued a series of well got up pamphlets describing the habitat of the commercially important lumber stands of Mysore. The characteristics of the sap and the heart woods such as texture, strength, susceptibility to decay, durability in contact with water, workability, decorative value and adaptability to certain special purposes, are indicated. We have no doubt that when the Forest Research Section is fully equipped with testing machines, we shall have quantitative data regarding the above characteristics. A small piece of panel of the timber in question attached to each of the pamphlets, adds vividly to the descriptive contents of the leaflet. These pamphlets will be of immense value not only in bringing to light the timber resources of the State, but also in advancing the technology of timber in general.

Announcement:

Indian Science Congress, 1940.—At the next session of the Congress to be held in Madras in the first week of January 1940, it is proposed to have the following 4 Discussions in the **Geology** Section:

1. The Ice Age (Pleistocene) in India (jointly with the Sections of Physics, Botany, Zoology, Entomology and Anthropology).
2. Types of Topography based on the erosion of rocks (jointly with the Section of Geography and Geodesy).
3. Possible Mineral Industries of South India (Section of Geology).
4. Classification and age limits of the Gondwana System (Section of Geology).

Members who wish to participate in one or more of these Discussions will please write, as early as possible, to Prof. L. Rama Rao, Department of Geology, Central College, Bangalore, enclosing, if possible, a summary of their contribution.

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We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, No. 12, and Vol. 59, No. 1.

"Agricultural Gazette of New South Wales," Vol. 50, No. 8.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 4.

"The Philippine Agriculturist," Vol. 28, No. 3.

"Monthly Bulletin of Agricultural Science & Practice," Vol. 30, Nos 6–7.

"Allahabad Farmer," Vol. 13, No. 4.

"Biochemical Journal," Vol. 33, No. 7.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 72, No. 8.

"Journal of the Institute of Brewing," Vol. 45, No. 8.

"Biological Reviews," Vol. 14, No. 3.

"Journal of the Indian Chemical Society," Vol. 16, No. 6.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

August 1939. SECTION A.—N. V. SUBBA RAO, J. VEERABHADRA RAO AND T. R. SESHADRI: *A note on the preparation and reactions of karanjin.*—Karanjin is only faintly bitter. A method of hydrolysis of karanjin giving rise to a good yield of karanjic acid has been found. P. A. MOSES: *Raman spectra of fused nitrates.*—Sodium, potassium and aluminium nitrates have been studied, and the polarisation characters of the Raman lines also determined. The intensity and polarisation in the wing accompanying the Rayleigh line λ 4046 of fused sodium nitrates show some characters as in common liquids. S. PARAMASIVAN: *The Pallava paintings at Conjeevaram.—An investigation into the methods.* S. PARAMASIVAN: *The wall paintings in the Bagh caves.—An investigation into their methods.* P. BHASKARA RAMA MURTI AND T. R. SESHADRI: *Chemical composition of Indian Senna leaves* (Cassia angustifolia).—The flavonol portion consists of iso-rhamnetin and kaempferol in more or less equal quantities, whereas the anthraquinone portion contains mostly rhein along with small quantities of emodin.

August 1939. SECTION B.—MAKUND BEHARI LAL: *Studies in Helminthology.—Trematode parasites of birds.* K. M. THOMAS AND C. S. KRISHNASWAMI: *Little leaf.—A transmissible disease of Brinjal.* B. R. SESHACHAR: *Testicular ova in* Uraeotyphlus narayani *Seshachar.* I. FROILANO DE MELLO: *Two new additions to the list of the Indian Aspergilli.*

Indian Chemical Society:

June 1939.—S. S. BHATNAGAR, A. N. KAPUR AND MAHENDRA SARUP BHATNAGAR: *Adsorptive properties of synthetic resins—Part III.* R. K. BAHL AND SRUJIT SINGH: *A study of the periodates of copper.* A. MUKHERJI: *The estimation of aneurin by the thiochrome reaction with pulfrich photometer.* (Late) N. W. HIRWE, G. V. JADHAV AND D. R. SUKHTANKAR: *Interaction of sulphuryl chloride with arylamides of aromatic acids—Part II. Orienting influences of groups in substitution reactions in aromatic compounds.* N. M. SHAH: *Chloralides, the condensation of Butylchloral with α-Hydroxy carboxylic acids.* MUHAMAD QUDRATI-I-KHUDA AND SUBASH KUMAR GHOSH: *Chemistry of substituted Ring compounds—Part I.—Synthesis of αα'γ-Trimethyl cyclopentanone.* JAGRAJ BEHARI LAL: *Studies in Chalkones—Part I. Chalkones derived from Resacetophenone and its dimethyl ether.* U. P. BASU AND P. K. DAS-GUPTA: *On 2-phenyl-4-aminoquinoline derivatives.* M. K. SRINIVASAN: *Viscosity of non-ideal binary liquid systems.* EDWARD BARNES: *A note on the action of strong solutions of alkalis on potassium ferricyanide.*

August 8, 1939.—DR. H. K. SEN: *Shellac in Moulding and Varnish Industry.*

Mining, Geological and Metallurgical Institute of India: *Transcations*

June 1939.—B. SEN AND M. V. WAZALWAR have expressed their views on Dr. Crookshank's paper on *"The iron ores of the Bailadila Range in Bastar State"*, with special reference to the possibility of exporting these ores to the Far East, Japan and China.

E. B. PARK has a paper of great importance on *Methods of detection and dealing with Heatings and Fires in coal mines"*,—which is eminently practical in its character. The discussion on this paper will no doubt be read with great interest by those who are concerned with the coal mining industry in India.

The methods of obtaining sand for hydraulic stowing in India, have been described by Messrs. L. J. BARRACLOUGH AND S. B. HALL, and this paper will be welcomed as a valuable contribution, full of practical details, on a subject of great current interest.

A short paper on *Quantity measurements in hydraulic mining by the Monitor* by MR. K. B. SWAMY, deals with the value of and method of carrying out, recurrent surveys for assessing the results of hydraulic mining of hill faces by Monitors, and with the duty of water in hydraulicking.

National Academy of Sciences, India:

August 4, 1939.—H. R. MEHRA: *New Bood Flukes of the family* Spirorchidae *Stunkard (Trematoda) from the Marine Turtle Chelonemydas of the Arabian Sea with the observations on the synonymity of certain Genera and classification of the family.* SHRI RANJAN AND V. R. JHA: *Studies on the effect of Ethylene and Sulphur dioxide on the fruits of* mangifera indica. SHRI RANJAN AND G. N. SAPRU: *Studies on the effects of Ethylene on the ripening process of Guava* (Psidium guava). N. S. JAPOLSKY, Davy Faraday Laboratory, Royal Institution, 21, Albemarls Street, London, W. 1. (Communicated by The Hon'ble Sir Shah Muhammad Sulaiman, KT.): *The Radion and the Electro-Magnetic whirl.* MAHADEO PRASAD GUPTA, JAGRAJ BEHARI LAL AND SIKHIBHUSHAN DUTT: *Constitution of Cuscitalin.* JAGRAJ BEHARI LAL: *Theory of Zinck's Reaction.* BRAJ KISHORE MALAVIYA AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil from the peels of Nagpur oranges.* BRAJ KISHORE MALAVIYA AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil* Curcuma caesia. JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the essential oil of* Hedychium spicatum. JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the seeds of Euphorbia dracumculoides: composition of the fixed oil.*

SUPPLEMENT TO "CURRENT SCIENCE"

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Dundee, 1939

THE PRESIDENTIAL ADDRESS

THE WESTERN ISLES THROUGH THE MISTS OF AGES

BY EMERITUS PROFESSOR SIR ALBERT C. SEWARD, SC D., D.SC., LL.D., F.R.S.

President of the Association

INTRODUCTORY

TWENTY-SEVEN years ago, when the British Association met for the second time in Dundee, Sir Edward Schäfer chose as the subject of his presidential address, the Nature, Origin, and Maintenance of Life; he discussed problems that will long continue to exercise the ingenuity and stimulate the imagination of biologists and chemists. A theme such as his is far beyond my reach. Seventy-two years ago the Association met for the first time in this city. The Duke of Buccleuch occupied the presidential chair, and the opening words of his address are applicable to one who now finds himself in this privileged position: the Duke said 'No man has a title to state that he is unworthy of the post he is called on to fill, whatever may be his private feelings as to his fitness for the post. To state that he is unworthy to be there placed is not only a disparagement to himself, but is no great compliment to those who thought him worthy of being so placed.'

This, in my opinion, is not an occasion on which it is desirable to follow the easier course and address oneself in technical language to fellow-workers in the pursuit of natural knowledge. The position which it is my great privilege to occupy affords a rare opportunity of talking to a large and, I venture to hope, a sympathetic audience including some at least who are repelled by the jargon of specialists. My intention is to speak in ordinary language on a subject of which I know enough to realise how little that knowledge is, and briefly to describe an example of the way in which, within one small patch of an illimitable field, a student asks questions of Nature and does his best to interpret the answers.

AN EXCURSION INTO THE PAST

I invite my audience to accompany me on an excursion of a kind which has substantially contributed to the enjoyment and enrichment of my own life, an excursion into a world that knew not man, with the object of deciphering from such records as we find in the rocks a few pages of the story-book of the earth. Each one of us can say with Shakespeare's soothsayer:

> 'In Nature's infinite book of secrecy
> A little I can read.'

As that great Scotsman, Hugh Miller, wrote nearly a century ago: 'We find the present incomplete without the past—the recent without the extinct.' To reinforce his own opinion he quoted Samuel Johnson: 'Whatever makes the past, the distant, or the future predominate over the present, advances us in the dignity of thinking beings.' We shall try to reconstruct a small part of an ancient land, a remnant of which is now called Scotland, and envisage a scene at a stage in the history of the earth separated from the present by at least sixty million years, a stretch of time difficult for us who

have been called 'the afterthoughts of creation' fully to appreciate. When we substitute geological standards for the modest time-scale of the human period and remember that the earliest chapters of the world's history are recorded in rocks at least two thousand million years old, sixty million years dwindle to comparative insignificance. All that it is possible to do is to lift a corner of the veil separating us from the world as it was and view through dimly illuminated vistas the forests and undergrowth on an ancient continent that is now represented by a few widely scattered, dismembered pieces.

The History of Plant Life

The history of plant life in the sea and on land is a branch of natural knowledge not unworthy of consideration by us human beings who owe our existence to the vegetable kingdom. Green plants in one vital sense are our superiors: from air and water they build up the complex organic substances necessary to our life, a feat beyond man's power. As members of a subject race we should be interested in endeavouring to unravel the history of the plant kingdom—in trying to trace the origin and relations of the several classes and groups as defined by botanists. The documents that are the sources of the botanical historian are contained in the earth's crust: as a preliminary it is worth while to ask ourselves of what these documents consist; how they came to be preserved in the rocks. In order to bring to life the past we must take the present for our guide: 'speak to the earth, and it shall teach thee.' There is no reason to think of Nature's methods as other than continuous. If we stand by the bank of a river flowing past tree-covered slopes we see on the sand and mud by the edge of the channel or floating on the stream leaves, twigs, and seeds that are random samples of vegetation scattered by wind or shed from overhanging boughs, debris swept along with off-scourings from the rocks to be carried eventually to a delta or an estuary where the water-borne material comes to rest. Beds of old sands and mud, with included fragments of contemporary trees and other plants, exposed on the faces of cliffs and ravines, are layers of sediment that have been raised to a higher level. In addition to leaves, twigs and other scraps easy to see on the split surface of sandstone or shale, sediments of former ages, especially such as are peaty, occasionally furnish another valuable source of information invisible to the unaided eye. Minute grains of pollen may be carried by wind to places where conditions are favourable for their preservation: fortunately the grains, or at least most of them, are protected by highly resistant coats and retain almost for all time their characteristic form and surface-sculpturing. With hardly any exception it is possible for a specialist, by comparative microscopical examination of fresh material, to assign fossil pollen-grains to their generic and occasionally their specific position in the plant kingdom.

There is another natural agency to which students of extinct plants are not infrequently indebted: the formation of rocks by volcanic action. From time to time volcanoes that have long been dormant eject clouds of ash: these with streams of lava poured over the rim of a crater spread havoc among trees and shrubs that had colonised precarious sites during a peaceful interlude. Vulcanicity is not only destructive: paradoxical as it may seem, forces inimical to life have contributed to the reconstruction of life which they destroyed. Scotland is exceptionally rich in botanical treasures that are legacies from ages of fire, and indeed the fossil plants with which we are concerned this evening owe their preservation to volcanic forces.

The following botanical retrospect is based mainly on results obtained during the last two or three years, but not yet published, by the joint efforts of Mr. W. N. Edwards, Keeper of Geology in the British Museum, Dr. J. B. Simpson of the Geological Survey, and myself.

Reconstruction of a Forest Scene

A. *The geological background*

(i) *Prolonged and intermittent volcanic activity.*—In order to present in true perspective the scene which it is my aim to bring to life, it will be helpful to visualise the physical features in north-western Europe some thousands of years antecedent to the phase of geological history chosen for closer examination. The Chalk Downs of England and part of the cliffs on the Antrim coast of Ireland are made of upraised calcareous material that was once a soft white ooze on the floor of a clear sea, a sea which had swept slowly and irresistibly over an enormous stretch of land, embracing the

greater part of England, northern Ireland and part of the region that is now western Scotland. With the uplifting of the chalky ooze from the ocean bed and the gradual recession of the waters a new land was born; a new chapter was inaugurated in the history of the earth. Following the great upheaval, as a consequential phenomenon, subterranean forces that had long been quiescent gained the upper hand: floods of semi-molten rock from deeply hidden reservoirs surged as a fiery deluge over the chalk downs, and over other and older rocks, converting thousands of square miles into barren lava-fields, extending over an area, not less than 2,000 miles from south to north, which reached far beyond the Arctic Circle. This unprecedented manifestation of volcanic energy, by no means confined to Europe and the arctic regions, but recorded on an equally titanic scale in the peninsula of India and elsewhere, is one of the wonders of geology; it is convincing evidence that the earth after the lapse of many hundred million years had not lost her youth; there was no sign of senescence. During the period we are considering most of Britain was land: we know that at a slightly later date a broad sea lay over the whole of what is now southern England. Travellers in the tube-railway in the London district may perhaps derive pleasure from the knowledge that they are being conveyed through a stiff clay upraised from the floor of that ancient sea. As an appropriate designation for the great northern land an American geologist suggested the name Thulean continent or province. (See map.) In the early days of the period called by geologists the Tertiary era, the greater part of the Thulean province was covered with sheets of sombre-coloured lava in nearly horizontal layers, products of a series of outbursts from deep fissures rent in the earth's crust under the compelling strain of subterranean forces and from localised volcanic centres of eruption. The columnar basalts of the Giant's Causeway, the columns of the 'cathedral of the sea' at Fingal's Cave, the basalts of Mull, Skye, Canna, Eigg, and other Western Isles, weathered into step-like terraces, which form a characteristic feature of Hebridean cliffs, the flat-topped McLeod's Tables of Skye (1,600 ft.), precisely similar basaltic platforms on the hills of Disko island and the mainland of western and eastern Greenland—all these are parts of one stupendous whole, a plateau covering half a million square miles, that was once the Thulean continent. The widespread lava-flows represent one phase of volcanic activity in an age of exceptional unrest. Another phase is illustrated by more coarsely crystalline rocks such as those of the dark Cuillin hills of Skye: they were not poured out as lava-streams over the land, but were forced upwards as great dome-like masses from a deeply-seated subterranean source and, as their coarser texture proves, slowly cooled under the pressure of a thick superincumbent load: the comparatively large size of the crystals indicates gradual solidification from a molten mass. These two phases of prolonged rock-building help us to appreciate the immensity of geological time. Describing the lava-flows of Mull, Sir Archibald Geikie wrote: 'On Ben More we can walk over each bed of basalt from the sea-level to the mountain top, a height of 3,169 ft.' The basaltic lavas we see in the cliffs of Mull and many other islands are but a part of the original pile: those that remain furnish an impressive example of rock construction which must have extended over an enormous period of time. The second phase, on the other hand, is an equally impressive example of rock destruction as a measure of geological time. We see the jagged peaks of mountains rising to a height of 3,000 ft. above sea-level which, at no distant date as earth history is reckoned, were buried under a considerable thickness of younger rocks that have been utterly destroyed by the ceaseless operation of denuding agents.

The world to our limited vision appears to be almost static; the mountains we have been accustomed to think of as symbols of eternity, seen through geological spectacles, take their place as episodes in a series of events which have moulded the changing features of the earth's face. The rocky covering of the world viewed by geologists, 'foreshortened in the tract of time,' reveals itself as a dynamic, mobile crust responding from age to age to constructive and destructive forces which have operated since the earth's early youth following a still earlier stage when, in the imagery of the poet,

'This world was once a fluid haze of light.'

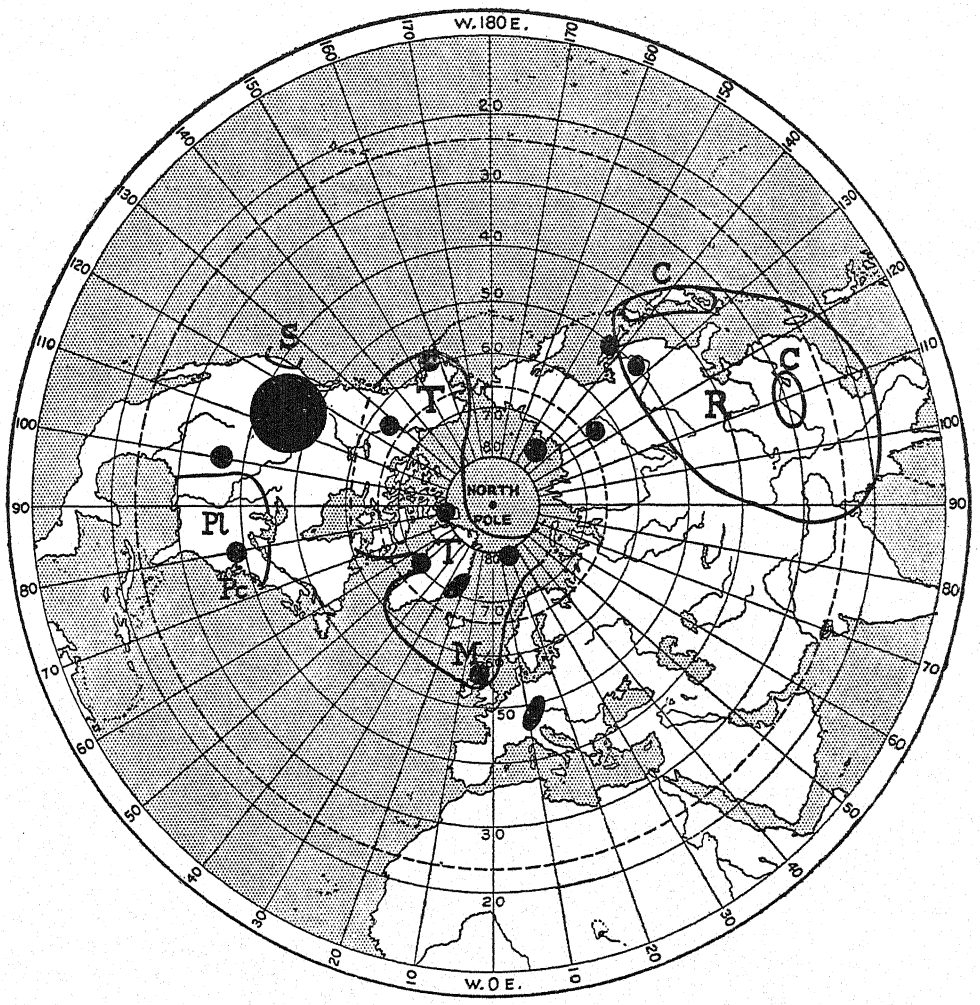
(ii) *Plant-bearing sediments indicative of quiescent intervals.*—So far the events chronicled in rocks of igneous origin have been spoken of as though there had been

continuous outpourings of lava with occasional showers of ash and, in some districts, upwelling of molten material that remained hidden below the surface until in the course of time the covering rocks were removed by erosion. There is, however, clear proof that the extrusion of lava and other rocks was intermittent: intercalated among the lava-beds are layers of sedimentary material, hardened sand and mud, layers of coal, and beds of fine-grained limestone containing beautifully preserved leaves, a few fruits and other plant fragments, also rare examples of insect wings and shells. The richest plant-containing layers occur near the base of the pile of basaltic lavas on Ardtun Head, the low 'headland of the waves' near the south-western corner of Mull, the island on which from his home on Iona—which has been aptly named 'the light of the western world'—Saint Columba must often have gazed. Trees, shrubs, and other plants were able to colonise portions of the lava-field during the long pauses between recurrent outbursts of volcanic fires.

The association of sedimentary material with the basalts at Ardtun Head was noticed by Abraham Mills as long ago as 1790; but it was not until the middle of the nineteenth century that Mr. McQuarrie of Bunessan discovered the fossil plants, which were very briefly described by Prof. Edward Forbes in an appendix to an important paper by the Duke of Argyll published by the Geological Society of London in 1851. The Duke spoke of the leaves as having been shed 'autumn after autumn into the smooth still waters of some shallow lake, on whose muddy bottom they were accumulated, one above the other, fully expanded and at perfect rest.' By far the richest collection of fossils was made by Mr. Starkie Gardner rather more than fifty years ago, and partially described by him in a paper read to the Geological Society of London in 1887. Descriptions of several fossil plants from the Mull beds have also been published by Dr. T. Johnson. The main collection is now in the British Museum. Additional specimens have been obtained by other collectors in more recent years. The work of deciphering the botanical records from Mull, Skye, and a few of the other islands is rendered mildly exciting by the danger of misinterpretation: fossil leaves, we are often reminded, are very uncertain guides—records left by Nature in a mischievous mood to mislead the unwary and over-confident student. Sir Joseph Hooker, in an address to the British Association at Norwich in 1868, spoke of Fossil Botany as 'this most unreliable of sciences'; but he added by way of consolation—'the science has of late made sure and steady progress, and developed really grand results.' One may cheerfully take the risk of being called an unscientific optimist by colleagues whose chief concern is with living plants. Botanists who confine their attention to recent plants have ample sources of information, not merely detached leaves but twigs bearing leaves, flowers, and fruits: it is natural, therefore, that they should tend to underestimate the value of leaf-form and venation, characters that are often the only criteria available to the palæobotanist.

B. *The ancient flora of the Inner Hebrides*

What then is it possible to say about the ancient flora of the Inner Hebrides without transgressing the limits of probability? We know very little of the smaller and simpler plants which lived under the shade of the forest trees or clung to the surface of stems where they were washed by trickling rills of rain-water. The three smallest plants which have left recognisable fragments are a fungus and two liverworts or, as they are often called, hepatics, a group allied to the mosses but of simpler construction. The fungus was found by Mr. Edwards several years ago on some detached leaves of a conifer from the Mull plant-beds: the manner of its discovery illustrates an interesting technique often employed with success by students of fossil plants. In many instances leaves preserved on shale are covered with a very thin, black coaly film produced as the result of chemical change in the plant tissues after death. It is often possible, by detaching a piece of the film and treating it with certain clearing agents, to remove the carbonaceous matter and obtain a sample of the surface skin of the leaf that is brown in colour, transparent, and suitable for microscopical examination. After treatment the Mull leaves showed some minute dark spots on the surface film, and these on magnification were found to be circular discs made of rows of radially disposed cells. The discs were identified as organs of a fungus closely resembling reproductive structures of a living genus *Phragmothyrium*, a fungus now mainly tropical: the occurrence in Mull of a nearly allied form is, however, probably



MAP OF THE NORTHERN HEMISPHERE ILLUSTRATING SOME OF THE SUBJECTS DEALT WITH IN THE ADDRESS

C,C. The present geographical distribution of *Cercidiphyllum*, a Japanese and Chinese tree.

Black patches mark localities and districts where fossil specimens of *Cercidiphyllum* have been found. Arctic and sub-arctic regions: Alaska, Mackenzie River, Grinnell Land and Ellesmere Land, West and East Greenland, Spitsbergen, New Siberian Islands, Lena River. Canada and the United States of America: several localities from British Columbia and California, and east of the Rocky Mountains in Montana, Wyoming, Oklahoma, etc. The oldest examples of *Cercidiphyllum* leaves are from early Cretaceous rocks in Maryland—the Potomac formation (Pc). Others are recorded from Europe—Mull, Switzerland, Bohemia, Silesia; Eastern Asia; Sakhalin Island and the Bureja River.

M. Mull and neighbouring islands.

Pl. The geographical distribution of the occidental plane.

R. Aproximate boundary of the area within which are the present homes of the majority of trees and shrubs most closely related to extinct species the Hebridean flora.

S. The present distribution of *Sequoia sempervirens* (Redwood) and *Sequoia gigantea* (Mammoth tree).

T. Hypothetical boundaries of the Thulean province.

indicative of a moist rather than a tropical climate. One of the liverworts bears a close resemblance to a living species, *Pellia epiphylla,* which has a wide geographical distribution and is very common on damp earth in Britain; it has a flat green, forked body barely an inch in length. The other hepatic is a member of a different family, characterised by a slender thread-like stem bearing two rows of minute leaves; it bears a striking resemblance to some living species included in the order Jungermanniales. These two fragmentary remains of liverworts are worth mentioning because fossil examples of such plants are comparatively rare; also for another and a more important reason. A few years ago Prof. J. Walton of Glasgow published a description of some liverworts discovered for the first time in rocks containing remains of plants which grew in the forests of the Coal Age about 200 million years ago. The interesting fact is this: the Palæozoic liverworts differ hardly at all in the construction of the delicate plant-body from the much later forms from the Thulean continent: both are essentially modern and yet both are surprisingly ancient. We do not know much about the history of these plants, but it is clear that some liverworts persisted through a succession of geological periods with practically no modification of their simple design.

The only fern so far discovered is very nearly related to the sensitive fern, *Onoclea sensibilis,* a familiar species in North America, ranging from Florida to Newfoundland and as far west as Saskatchewan; it occurs also in northern China, Manchuria, Japan, and Corea: it has what is called a discontinuous geographical distribution. *Onoclea,* no longer a native of Europe, is often cultivated. The fossil fronds from Mull, both sterile and fertile, differ hardly at all from those of the living fern. Records of the rocks show that *Onoclea* formerly grew in north-western Europe and in Greenland, regions where through the vicissitudes of climate, it long ago failed to survive. Evidence furnished by fossils and the facts of geological history affords a clue to the present discontinuous range: in all probability *Onoclea* originated on the Thulean continent, perhaps north of the Arctic Circle, whence it spread radially into America, Europe, and the Far East; in the European region it became extinct, sharing the fate of many other plants that were unable to survive the rigours of the Ice Age. Its territory was originally continuous; now it is restricted to North America and eastern Asia. Another member of the class to which the ferns belong is the familiar *Equisetum,* the horsetails: one species, closely comparable with the living *Equisetum limosum*—widely distributed in north temperate and arctic lands—has been found in the sediments of Ardtun Head. *Equisetum* may be described as an emblem of changelessness: nearly related forms grew in palæzoic forests at least 150 or 200 million years ago: less closely related plants in the same forests—the calamities—were comparable in size with trees. The slender horsetails of the Coal Age and their much more robust and woody allies remind us that in the course of evolution some of Nature's early experiments survived unaffected by the production of new competitors, while others, less successful, left no direct descendants. As we follow the march of plant-life through the ages evidence of progress accompanied by retrogression becomes recurrently apparent: in the varying green mantle of the earth there can be traced threads running through the whole, changing very slightly as we follow them onwards and upwards, preserving all the time a remarkable uniformity in essential characters.

By far the greater number of the fossils from Ardtun are leaves of trees or shrubs, which belong to one or other of the two great classes of seed-bearing plants. In Gymnosperms, including conifers and some other less familiar plants, the seeds are naked. In members of the other class, the highest, the most various and most abundant in the vegetable kingdom, the seeds are more efficiently protected and are contained in a closed case; hence the name Angiosperms. Conifers played a prominent part in the Hebridean forests, but their representatives were not such as we find in modern Europe. A single and well-preserved seed attached to a relatively large wing affords evidence of the occurrence of a conifer allied to the Silver fir (*Abies pectinata*) and some other species commonly cultivated in Britain. Firs, using the term for trees belonging to the genus *Abies* and excluding the Spruce fir (*Picea*), now occur in Europe, northern Africa, northern Asia and America: there is no British species of *Abies.* The Mull seed, it is important to note, agrees most closely with seeds of firs now living in China and Japan. Among other conifers discovered in the

plant-beds of Mull and Skye are *Cephalotaxus, Cryptomeria,* and *Sequoia.* Recent species of *Cephalotaxus* are comparatively small trees confined to the Far East; some kinds are cultivated in our gardens. The foliage of the Mull species bears a striking resemblance to that of *Cephalotaxus fortunei,* a small tree widely distributed in China. Another genus which we believe to have been a member of the Hebridean flora is *Cryptomeria*: the fossils from northern Ireland and the Isle of Skye include foliage shoots, cones, and pollen-grains. The solitary living species is the Japanese *Cryptomeria japonica,* which occurs also in China: this is the tree of the famous avenue of Nikko in Japan, a noble memorial of a peasant who was too poor in worldly goods to contribute the usual building stone or a bronze lamp to the mortuary temple of an emperor, and instead offered to plant trees to protect visitors against the heat of the sun.

One of the most interesting of all living conifers is the genus *Sequoia,* of which there are two species confined within the narrow strip of hill ranges bordering Oregon and California on the Pacific coast—the Redwoods (*Sequoia sempervirens*) of the Coast Range, watered in the dry season by mists from the western ocean, and the Mammoth trees (*Sequoia gigantea,* often called *Wellingtonia*) of the Sierra Nevada. (See map, S.) *Sequoia* is an impressive example of the light thrown by fossil plants on the past history and wanderings over broad regions of the earth's surface of trees that, without man's protection, would be in danger of extinction. In earlier periods *Sequoia* was almost cosmopolitan; it ranged over wide spaces in the old and the new world and overstepped the limits of the northern hemisphere. Foliage shoots preserved in the sediments of Mull were in all probability borne by trees closely related to the living Redwoods, trees which are well worthy of inclusion among the wonders of the world; they attain a height of over 300 feet and the rings on cross-sections of giant trunks that have been felled bear witness to an age of 3,000 years and more. They were growing where they stand to-day 1,000 years before the Christian era. Trees next of kin to the Redwoods once lived within a short distance from the Polar Sea several hundred miles farther north than the present tree-limit. Another species of *Sequoia,* more nearly allied to the Mammoth tree, lingered on in Britain long after the disappearance of the Thulean forests: this we know from the discovery of fossil twigs and cones in the sediments of an old lake on the edge of Dartmoor in Devonshire. The two surviving species live in splendid isolation, dreaming of a greater glory that was theirs, their memories stored with secrets man can never know.

There was another naked-seeded tree in the forests into which we have intruded, a species of *Ginkgo,* the Maidenhair tree. The barbarous name *Ginkgo* invented in 1712 by the German naturalist Kaempfer, is in the opinion of the Rev. Dr. Moule, formerly Professor of Chinese at Cambridge, a false transcription of Sankyo, which probably means hill-apricot. Leaves perfect in form and venation were found in the chalky sediment of a lake that filled a hollow in the Hebridean lava-field; they differ from the foliage of the living tree only in a few minor features detected by the practised eyes of Dr. Florin of Stockholm in the microscopical structure of the superficial cells. Dr. Simpson discovered *Ginkgo* pollen-grains at another locality. The story of the Maidenhair tree has recently been told (*Science Progress,* January 1938), and the temptation to linger over it this evening must be restricted. *Ginkgo* of all trees furnishes the most thrilling example of a link with the past; its history compiled from fossils of many geological ages and in many parts of the world is an enthralling romance. This is but one of many histories recorded in Nature's story-book which makes us share the thought of Edward Fitzgerald: 'Yes, as I often think, it is not the poetical imagination but bare science that every day more and more unrolls a greater epic than the Iliad.' It would be rash definitely to assert that the Maidenhair tree still exists under strictly natural conditions as a wild tree of the forest. Botanists who have searched for it in China, the country believed to be its last home, failed to discover convincing evidence of the occurrence of specimens which could not be ascribed to man's agency. On the other hand, a few years ago a Chinese botanist expressed the opinion that *Ginkgo* still grows wild in the province of Chekiang in eastern China. The oldest living examples occur in China and Japan, often in places where, as is fitting, they are venerated as trees endowed with healing properties. The history of *Ginkgo*

has been traced to periods antedating by millions of years the Thulean forests: we do not know of what sort its progenitors were; but we know that it is a survival from an age too remote for us to measure in terms which we can fully appreciate. We also know that *Ginkgo*, now a lonely relic in the present world, is a primitive and isolated type, the sole representative of a large family, including many different members, all of which save the Maidenhair tree long ago fell by the way in the struggle for existence. When the tree lived in the Hebridean forests it was common in other parts of the Thulean continent from northern Canada to Greenland and Spitsbergen, in North America, Europe, and Asia. It was as widely distributed geographically as oaks, pines, and firs in the modern world. The history of *Ginkgo* is a record of endurance, of persistence with apparently little change in an unstable world. When we recall the amazing life-story of the tree and its forbears the autumnal colour acquires a deeper significance: we see in the pale yellow of the leaves a reflection of the golden age of a family that left a precious legacy. Would that the Maidenhair tree were endowed with the oracular power of the oaks of Dodona and, in the trembling accents of its fluttering leaves, could tell us not of the future but of the varying fortunes of the family as age succeeded age.

The *Ginkgo* of Mull was not the last of its race in Europe: well-preserved remains have been found in younger rocks in France and Germany proving that it survived in the western world, though probably only in a few places, to an age preceding by a comparatively short period the invasion of temperate Europe and North America by arctic ice-sheets and glaciers, which had a far-reaching effect upon the vegetation in the western world.

Leaving the naked-seeded plants, we pass to the flowering plants or Angiosperms. This class is more recent in origin than the Gymnosperms, at least so it would seem, and as in present-day floras so also in the Thulean forests, flowering plants contributed the greatest number of genera and species. We shall take first a few trees and shrubs which have descendants still living in Europe, and afterwards mention others that have no near relations in European floras. There were, we think, three or four kinds of oak, all different from those now living in Europe and America. The largest leaves from Mull assigned to the genus *quercus* are oval, with a broadly rounded base and relatively small teeth; they resemble the foliage of a few Indian species, but the oak with leaves most closely resembling the fossil form is *Quercus serrata*, a native of China, the rain-forests of Assam, Japan, Corea, and the Himalayas. A second species from Mull is closely comparable with other Indian and Far Eastern oaks; and a third form of leaf is very similar in shape and venation to a species that now has its home in China, Assam, and the island of Formosa. It is noteworthy that none of the oaks of the Thulean forests conformed in pattern of the foliage to our familiar British trees.

One of the most conspicuous trees in the Hebridean woodland was a plane (*Platanus*) with large handsome leaves almost, but not quite, identical with those of the existing occidental plane of North America. The fossil evidence in this instance is supplied by male flowers and fruit-balls as well as leaves. As in all living planes the expanded base of the leaf-stalk enclosed and protected a bud. There is, however, one interesting feature in which the leaves of the Mull tree differ from those of any living plane: there were two fairly large leaflets attached to the long leaf-stalk between the main part of the leaf and the base of the stalk. The significance of this peculiarity need not be discussed; it is one of those botanical problems of academic interest which excite the specialist. A more important fact for us is that plane trees in the period we are considering occupied a territory which extended very much farther north than the present area of distribution. Remains of plane trees have been found as far north as Spitsbergen in rocks approximately equivalent in age to those of Mull. There are in the world to-day six or possibly eight different kinds of plane: the oriental plane (*Platinus orientalis*), the only species native in Europe, is one of the noblest living trees; it recalls the groves of the Academy in the golden age of Greece. One of the oldest specimens in the venerable stump bearing enormous arms in the market place on the island of Cos where, legend would have us believe, Hippocrates, more than two thousand years ago, gave advice to his patients under the shade of the

youthful tree. The oriental plane extends from Greece and the Aegean islands eastward to Asia Minor and the Caspian Sea; it it sometimes said to be wild in Persia and northern India, but more probably this eastward spread should be attributed to man. The most widely distributed species in the New World is *Platanus occidentalis*, growing usually in river valleys from Lake Ontario to Florida and west to Texas and Nebraska (see Map, Pl.). On the western side of North America there are other species, in Mexico and along the Coast Range hills of California. The most familiar cultivated species in Britain is *Platanus acerifolia*, the so-called London plane: this favourite urban tree is regarded by some botanists as a hybrid between the oriental and the occidental plane; the time and place of its origin are not known with any certainty. The geological record of *Platanus* affords a striking example of contrasts between past and present areas of distribution. Some of the oldest known fossil leaves and fruits are from early Cretaceous beds in Greenland, at least 300 miles north of the Arctic Circle. The occurrence of these remains in sediments that were deposited in a remote northern estuary before the chalk of the British Isles had been upraised from the sea-floor affords definite proof that plane trees lived in arctic forests millions of years before they spread to the southern part of the Thulean continent. The birthplace of *Platanus* may have been in the far north, whence in course of time it spread to Iceland and Spitsbergen, from arctic to temperate North America and Europe, and wandered as far east as Sakhalin Island on the eastern confines of Asia.

One of the comparatively few trees in the Hebridean forests related to recent British species was a *Corylus* with leaves similar to those of our hazel but still more like the foliage of species now living in India and the Far East. Hazels were associated with planes not only in the ancient flora of Mull but in circumpolar forests from which they travelled, in response to the urge of climatic change, to fresh and more genial homes farther south. Another tree in the Thulean forests was a cornel, a species of the genus *Cornus*, which has a far-flung distribution, in arctic and sub-arctic countries, in North America, Europe, and Asia. While fully conscious of the danger of placing excessive trust in leaves as evidence of affinity, we believe that a Chinese cornel (*Cornus chinensis*) agrees most closely in foliage with the Mull species. The cornels are members of an old stock represented in northern forests as long ago as the Cretaceous period.

Among the larger fossils from Ardtun Head are a few almost perfectly preserved leaves of a vine, which we believe to be specifically identical with specimens previously discovered in Alaskan rocks of approximately the same geological age as those associated with the lava-flows of Mull. Similar leaves have been described from Greenland, Iceland, Spitsbergen and more southern localities in America and Europe. Vines were widely distributed even as far back as the Cretacious period: there is now only one European species, the wine-producing *Vitis vinifera*; but its leaves are unlike the fossils from Ardtun. The striking contrast between the present distribution of the vine in Europe and its former, much more extended distribution which included arctic and north temperate regions, raises the difficult problem of changes in climate from one age to another. Vine scrolls are a fairly common ornament on early Northumbrian Anglo-Saxon crosses, a motif adopted in still earlier ages by Greek and Roman sculptors, which, after the lapse of centuries, reached the highest expression of naturalistic treatment in England in the last two decades of the thirteenth century. Millions of years before vine leaves and fruit were fashioned in stone, one kind lived in pre-human days on the Thulean continent; and it is noteworthy that its nearest counterpart in the modern world occurs in the Far East.

We turn now to trees and shrubs belonging to genera which are no longer living in Europe. The first tree to be considered furnishes a striking contrast, in the narrow limits of its present geographical area, to the widely spread cornels and oaks. *Cercidiphyllum* is now confined to Japan and mountain valleys in some parts of China (see Map, C.). The name *Cercidiphyllum* was chosen because of a superficial resemblance of the leaves to those of the Judas tree, *Cercis siliquastrum*: Only a single species, with a few varieties, has survived, *Cercidiphyllum japonicum*, familiar to many tree lovers who cultivate it for the sake of the exceptionaliy beautiful gold, pink, and red parti-coloured autumnal foliage. In common with some other trees

of ancient lineage, *Cercidiphyllum* lacks any near relations in the present age; it is one of a select company of Nature's anachronisms. Like the Maidenhair tree, it is an aberrant type, a relic living within a comparatively small area in the Far East: formerly it was one of the most widely distributed forest trees on both sides of the Atlantic Ocean. Several beautifully preserved leaves have been found in the plant-beds of Ardtun Head, leaves and occasionally fruits of *Cercidiphyllum* have been found in Grinnell Land and Ellesmere Land on the north-eastern corner of the Canadian Archipelago, in Alaska and at several localities on the Pacific and Atlantic coasts of North America, in Greenland, Iceland, and Spitsbergen, as well as in Switzerland and other parts of Europe (see Map). Leaves, superficially at least indistinguishable from those of the existing species, are recorded from sedimentary beds in the valley of the Potomac River in Maryland assigned to the early days of the Cretaceous period when flowering plants were comparatively few in number and had not yet come into their own as the dominant class in the plant kingdom. When we remember the remote antiquity of *Cercidiphyllum* and its wanderings over the earth's surface during the passing of millennia, the autumnal glory of its foliage is enhanced a hundredfold and acquires a symbolic meaning.

The plant-beds on the headland of Ardtun have yielded very few recognisable fruits and seeds. Among the rare examples of fruits are some, about half an inch long, consisting of a slightly elongated seed-vessel surmounted usually by five leaflets, the enlarged and persistent covering of the young flowers, which served as efficient aids to dispersal by wind. The fossil winged fruits and associated leaves present a remarkably close resemblance to those of some living species of *Abelia*, a genus named after Mr. Clarke Abel, who discovered the shrub in China about one hundred and twenty years ago. *Abelia* is a member of the honeysuckle family (*Caprifoliaceæ*): most of the existing species have their home in Central China and are cultivated as flowering shrubs in European gardens. There are a few species in Japan, the Himalayas, and Mexico. Fruits of a Chinese *Abelia* agree most closely with the fossil specimens. Similar, though not specifically identical, fruits were discovered thirteen years ago by Mrs. Clement Reid and Miss Chandler in a collection of fossil plants from Bembridge in the Isle of Wight. The Bembridge flora is younger geologically than the flora of Mull and indicates a warmer climate. Other examples were recorded long ago from south-eastern France. It is therefore clear that shrubs next of kin to Abelias now living in China were once native in western and northern Europe. The introduction to British and continental gardens in our time of *Abelia, Cercidiphyllum,* and other trees and flowering shrubs may be described as the reinstatement, through man's desire for horticultural novelties, of plants that had long been exiles from western woodlands where as natives they were never seen by human eyes.

So far attention has been confined to a selection of plants identified from leaves and a few fruits. If time permitted, the list could be substantially enlarged by inclusion of the interesting results of Dr. Simpson's intensive study of pollen-grains, which he found by microscopical examination of broken-up pieces of lignite and coal, associated with sandy beds in Mull and on the adjacent peninsula of Morven. The pollen-bearing layers of rock are below the basaltic lavas and therefore slightly older than the leaf-beds of Ardtun Head. Dr. Simpson discovered several conifers and flowering plants confirmatory of identifications based on leaves; he also made many additions to the list compiled from leaves, fruits, and seeds. Three of his discoveries are selected for brief reference. He found pollen-grains of two kinds of alder (*Alnus*): the pollen of alders has a very characteristic structure and can easily be recognised. The occurrence of alders in the Hebridean flora supplies one of the few links between the extinct and the present European vegetation. The second genus chosen from Dr. Simpson's list is *Magnolia*: it is now represented by many species, both trees and shrubs, and is widely distributed on two sides of the Pacific Ocean: in Asia along the Himalayas and in parts of Tibet, over a large area in China, Japan and Corea, the Malay Archipelago, and Indo-China; in America from southern Ontario as far south as Central America and Cuba. It was shown many years ago that *Magnolia* formerly lived in Europe and flourished as far north as lat. 70° N. in Greenland; we now know that

it played a part in the adornment of the Thulean forests.

Finally a few words on the discovery of pollen-grains believed to belong to a species of *Nelumbium*: this genus is one of the most attractive water plants, a plant held sacred in ancient Egypt and venerated in the Far East. One of the living species is the sacred lotus, native in China and Japan and established as far west as the Caspian Sea; the other species has an extended range in North America, spreading as far south as the West Indies and Brazil. *Nelumbium* no longer grows in the Nile: Long years ago it had a wide distribution in Europe, both in the Cretaceous period and in later ages. Looking backwards we see its great circular leaves spread over the still waters of a Thulean lake.

It is important to note that Dr. Simpson's comparative investigation of fossil and recent pollen shows a preponderance of eastern Asiatic species in the Hebridean flora.

Fancy with Fact

We have attempted to re-create a scene in the past, and it is natural to ask—how does our reconstruction compare with reality? As it is impossible to satisfy curiosity by an actual flight to the Thulean continent, we can at least imagine ourselves miraculously transported to a destination where the past has become the present. At a very early stage of the backward journey we should see the greater part of the land being gradually obliterated by a covering of snow and ice; glacial conditions would be succeeded by a climate becoming more and more genial. Human beings would be missed before one-fiftieth of the flight had been completed. At last, after observing the moving panorama of land and sea, fluctuations in climate and changes in the character of the vegetation, let us imagine ourselves at the journey's end. Combining fact with fancy, we find ourselves, where in day-dreams we have often been, among the plants on the lava plateau. Thanks to the artistic co-operation of Mrs. Gwendy Caröe, it has been possible to give substance to our mental picture based on geological and botanical facts. It requires a special effort for us, who think of ourselves as overlords in Nature's realm, to visualise a world in which man has no place. Alone in a world which for millions of years to come would be uninhabited by the human race, we could hardly fail to look upon the beauty of Nature's pageantry with a strange and more penetrating vision:

> 'Beauty, the eternal Spouse of the Wisdom of God
> and Angel of his Presence thru' all creation.'

We should realise as never before man's insignificance: on the other hand, our estimate of spiritual values would be raised to a higher level and we should experience a deeper sense of union with the infinite. Our tendency is to think of the past, as we think of the present—in relation to man; we forget his very recent participation as an actor in life's drama. As we look at Nature as into a mirror our own image obtrudes itself into the foreground. Had man been a dweller on the Thulean continent he would have seen, as we see, the sun by day setting in motion the living machinery of trees and herbs; the splendour of the evening sky; he would hear the wind in the trees, the music of running water and the songs of birds. The beauty of Nature is eternal. To the east and north beyond the lava-fields the Caledonian mountain ranges would be seen rising to greater heights than any of their peaks reach to-day; they were still to be exposed for millions of years to the destructive operation of Nature's sculpturing tools. Making a fresh demand upon our imagination, let us take a longer view over the curve of the earth towards the heart of Europe and far to the east to northern India. We should look in vain for the Pyrenees, the Alps, the Carpathians, and the Himalayas: these and other mountain ranges had not yet been lifted up; the time of their birth was not far off. We should see in their place a broad belt of water stretching from the Atlantic to the Indian Ocean, linking West with East. On the bed of this ancient sea—the Tethys Sea of geologists—sediments had long been accumulating, and these, with other rocks of igneous origin, would be involved at no distant date in a complete transformation of the earth's features and the crumpling of the crust into the 'everlasting hills'.

Returning to the Thulean continent at a place near the present geographical position of the Inner Hebrides, let us take a survey of the vegetation. We should be impressed by its luxuriance: at first sight the general

aspect would seem familiar, but on closer examination of the trees and shrubs we should find only a few recalling modern European species; many would remind us of exotic plants of eastern origin. Despite the immensity of the time interval separating us from the world we had left, we should not be aware of any such marked contrast in the general character of the vegetation as we might have expected. The plants had already put on their familiar dress and would seem to us surprisingly modern. But—and this would be the deepest impression—we should feel that we were among trees and shrubs that were reminiscent of remote eastern forests. We should be conscious of the dynamic character of the plant-world; we should be driven to the conclusion that the forests were mainly composed of wanderers resting for a time in a temporary home whence, as conditions changed, they would pass to other stages in the long journey to their present refuges in Asia.

Evolution

There remains another question which is always asked by those who attempt to reconstruct the vegetation of past ages: what contributions do the records of plant-life make towards a better understanding of evolution? The riddle of evolution remains a challenge and, as knowledge increases, we make fresh guesses. As a Cambridge friend writes in a recent volume of *Provocative Verse*:

> 'That life evolves was guessed of yore,
> Darwinians prove it true;
> Of how and why we know but little more
> Than old Lucretius knew.'

The little more we know urges us to continue in hopeful expectancy the long and endless prying into Nature's methods. What then do we learn from the ancient flora of the Western Isles? The facts do not substantially help us to trace the unfolding of life in the long interval separating the older part of the Tertiary era from the present time. There is little difference between the past and the present vegetation of the world as a whole in the nature of trees, shrubs, and ferns: our knowledge of the earlier history of herbaceous plants is very meagre. The fossil flora of Mull represents an early phase of what may be called the modern type of vegetation, which overspread the world in the later stages of the Cretaceous period and has persisted with few major modifications until now. Evolution seems to have been characterised by bursts of production when new and successful types exercised a transforming influence; and these periods of exceptional creative activity were separated by periods of relative stability. The early Tertiary floras belong to a stage when a new order had become well established and an older order had passed its prime. The one great difference that emerges from comparison of the Mull flora and the existing European floras is not a difference in the components of the world forests, but a contrast in the geographical positions occupied by the various genera in the northern hemisphere: for the most part a western home has been exchanged for a home in the Far East.

Drifting Continents

If we followed the vegetation on the southern part of the Thulean land farther to the north, we should be impressed by its apparent indifference to changing physical conditions as we travelled beyond the Arctic Circle; we should fail to notice any zonal distinguishing characters in the floras such as in our day reflect the passage from temperate to arctic regions. The evidence of fossil plants forces us to the conclusion that the vegetation on the Thulean continent, its northern boundary within a short distance of the polar sea, its southern border on the latitude of northern Ireland and western Scotland, was astonishingly uniform. How, we ask, can we explain this surprising and well-attested fact? There must, it is generally agreed, always have been climatic belts; high arctic and much lower temperate regions cannot have supported closely comparable floras possessing several species in common. Some of us are convinced that changes in geography from one period to another, land connections where there are now arms of the sea, interference with paths of ocean currents and consequential changes in temperature are inadequate as explanatory causes. What then remains? Were it possible for us to make a survey of the Thulean continent as it was, we might find that the geographical relation of the northern part of the forest-clad land to the North Pole was by no means the same as it is now. It is difficult, it is probably impossible, to explain the facts without calling to our aid the hypothesis of drifting continents usually

associated with the late Prof. Wegener and recently discussed in an able book by Prof. Du Toit of South Africa. This is a controversial subject beyond the scope of my address: I can do little more than reaffirm adherence to the view that plant records from rocks of many ages raise problems which seem to be insoluble unless we postulate movement and sliding of the earth's crust. As icebergs are slowly drifted by ocean currents, as masses of cumulus clouds rapidly changing shape pass across a blue sky; so, the rate of travel enormously reduced, large slabs of the outermost rocky shell of the world may have shifted their position in the course of geological time. It must, however, be admitted that as yet refined methods of measurement have not furnished any evidence of crustal movement. Dr. Norlund of Copenhagen has stated that longitudinal determinations, carried out by the Danish Geodetic Institute in 1927 and 1936 with a modern transit instrument, both times on the same pillar at a locality on the west coast of Greenland, gave practically the same result. In his presidential address at the Norwich Meeting of the Association in 1935 Prof. W. W. Watts made an interesting and judicial reference to the Wegener hypothesis: he spoke of it as having been hailed by many classes of investigators as almost a panacea, and quoted one of several critics who called it a beautiful dream, the dream of a great poet.

Proof or disproof of the Wegener hypothesis will be forthcoming in the more distant future when the precision of modern methods of measurement has been available long enough to provide trustworthy data. Meanwhile we must be content to wait in sanguine expectation that an interpretation of the overwhelming evidence furnished by fossil plants will be provided by research workers in the geophysical field.

One of the most impressive examples of the bearing of fossil plants upon the fascinating problem of climatic conditions in the past has been furnished by Prof. Harris of Reading. The facts are briefly these: several years ago Prof. Nathorst of Stockholm described a large collection of fossil plants from rocks in Scania, the southernmost province of Sweden, demonstrating the existence of a flora many million years older than the one we have been considering. It was a very rich flora composed of numerous ferns, conifers, and other plants; it probably lacked flowering plants. More recently Prof. Harris made a still larger collection of fossils during a long visit to eastern Greenland in the ice-bound district of Scoresby Sound where, under extreme arctic conditions, only a few stunted plants are able to exist. Nothing could be more striking than the present contrast between the floras of eastern Greenland and southern Sweden. The arctic fossil plants of the same age as those from Scania demonstrate the former existence of a flora even richer than that from southern Sweden: comparison of the two floras affords no indication of any difference in the size of individual plants and no difference in the vegetation as a whole. A luxuriant and uniform vegetation occupied an area stretching from central Germany to southern Sweden and a thousand miles farther north beyond latitude 70° N. The fossils preserved in rocks at localities within this far-flung geographical area from south to north give no indication of any such change in the plant communities as we should expect and as we find when we contrast arctic and temperate floras in the present world. This uniformity, I venture to think, is inexplicable unless we assume a very considerable movement and reshuffling of the earth's crust. The geological historian needs the co-operation of astronomers and physicists in his endeavour to reconstruct the world at the successive stages of its development; he looks to them to prevent him from making assumptions inconsistent with conclusions reached by workers in other fields. On the other hand, geologists and palæontologists contribute facts that are incontrovertible however much they seem to be in opposition to the views of students whose primary interest is in geophysical problems.

Neglect of Earth History in Education

There are still some people who ask, what is the use of the kind of information given in this address? My reply is that knowledge gained from a first-hand study of nature, both animate and inanimate, has a value beyond price. Enjoyment of the romance of creation as recorded in the life of the past and of the present is within the reach of all who have the desire to read the open pages of Nature's book. In the rocks we find the soul of history: the whole world

throbs with life, and the joy of it all is ours to share:

'I said it in the meadow path,
I said it on the mountain stairs—
The best things any mortal hath
Are those which every mortal shares.'

This evening we have caught through the mists a glimpse of a scene on earth's stage separated from the present by a small fraction of time in relation to the whole span of geological history. The Thulean forests which we have visited included trees, shrubs, and other plants of surprisingly modern aspect, though it is not to be supposed that they were absolutely identical specifically with their living descendants; from the material available it is impossible to define or assess the difference. What we have seen throws little light on the evolution of the plant-world; it is equally true that the main conclusion forced upon us by our retrospect cannot fail to convince us that it is impossible to understand the present distribution of plants over the earth's surface unless we extend our survey into the past. Darwin spoke of geographical distribution as a noble science, 'almost the keystone of the laws of creation'. The living world cannot be fully appreciated as an expression of creative energy unless we free ourselves from the cramping influence of the environment in which we live.

As a botanist whose first love was geology, may I make a plea for wider recognition of physical geography and geology as branches of knowledge possessing an inestimable value as a means of bringing young people into close companionship with Nature and as a source of refreshment, a stimulus, and an inspiration. Most of us would probably agree with the spirit of a remark made a good many years ago by the late A. C. Benson: 'I find it hard to resist the conviction that, from the educational point of view, stimulus is more important than exactness.' Arguments in favour of introducing geology into schools were put forward in a Report on Scientific Education presented at the Dundee Meeting seventy-two years ago, and in 1936 and 1937 the Association published two Reports on the same subject. Let me add another argument of no little value: Hugh Miller wrote in a letter to a friend, 'geology is, I find, a science in which the best authorities are sometimes content to unlearn a good deal.' That is worth much: geology helps us to cultivate the not too common virtue of admitting that it is possible to make a mistake. In conclusion, I cannot do better than quote with wholehearted agreement words spoken by Sir William Bragg in his presidential address to this Association eleven years ago: 'Some speak of modern science as tending to destroy reverence and faith. I do not know how that can be said of the student who stands daily in the presence of what seems to him to be infinite.' These words apply with equal force to searchers after truth whose main interest is in the living world no less than to those whose objective is the elucidation of the structure of matter that is called by contrast dead and yet vibrates with life. The earth was once lifeless: when and how living protoplasm had its birth we do not know, nor do we know whereupon were the foundations of the earth laid. We can only echo in our hearts the voice out of the whirlwind:

'Whereupon were the foundations thereof fastened?
Or who laid the corner-stone thereof;
When the morning stars sang together
And all the sons of God shouted for joy?'

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The Mettur Dam Fisheries

THE Cauvery Irrigation System dates from time immemorial. Improvements to the system under the British rule date from 1801 when the *East India Company* took over the Tanjore District: reforms on modern lines may be stated to have commenced from 1836 when Sir Arthur Cotton, the father of most of the irrigation systems of South India, built the upper anicut. Further improvements followed which rendered the distribution of water when available in the river complete. But there still remained the problem of fluctuating supplies and long periods of drought. The solution was a storage reservoir and the Stanley Reservoir was finally decided on in 1910. The construction of the Mettur Dam, the second largest in the world, was commenced in 1925 and completed in 1934. The lake comprises a thirty-three mile length of the river and has an area of sixty square miles. It holds 93,500 million c. ft. of water and is expected to irrigate no less than 1,352,000 acres.

Unfortunately the effect of the Dam on the fisheries of the river below was disastrous. The number of valuable Indian Shad or Hilsa, the most important sea-fish ascending the Cauvery for breeding purposes, has seriously declined as the high floods which enabled them to ascend the river no longer occur. The heavy scores and the consequent deep pools all along the river caused by natural floods are gradually disappearing and the breeding fish of all kinds which sheltered in them are gradually

decreasing in number. The serious decline of the fisheries of the Cauvery will be evident from the fact that the fishery rentals of the river below the Dam in the Salem, Coimbatore, Trichinopoly, Tanjore and South Arcot Districts which used to amount to over 80,000 rupees annually has steadily declined since the formation of the Dam to about 42,900 rupees. When these fisheries which used to be under the control of the respective District Boards were taken over by the Fisheries Department for scientific organisation and development two decades ago, the average annual rentals used to be only about Rs. 41,000 which was paid as compensation every year to the five District Boards concerned.

The benefits of scientific control and culture which rapidly increased the rentals of the Cauvery by over 100 per cent., *viz.*, from Rs. 41,000 to Rs. 83,000 in the course of the first fifteen years have been undermined by the formation of the Mettur Dam. Serious efforts were therefore made to plan the development of the fisheries of the Mettur Reservoir to its maximum capacity.

A fish farm, a hatchery and an appropriate technical staff were sanctioned by Government in 1936. The farm and the hatchery are under construction. But a close study of the fisheries, their improvement by the formation of sanctuaries such as a four-mile reach immediately below the Hoginkal falls, and the Ellis surplus and other outlet channels to prevent undue destruction of fish, the complete prohibition of fishing in the lake in spite of ignorant opposition, the stocking of the Reservoir with new and improved varieties of food-fish, have all contributed during the last five years to a marked improvement of the fisheries of the lake and are paving the way to a resuscitation of the fisheries of the Cauvery. As the lake now holds a large number of food-fish, not the least important of which is the newly introduced North Indian carp, catla, which attains to hundreds of pounds in weight and is the most prized of the carps in the lake, it was decided to commence the exploitation of the lake from this year.

If the problems of development necessitated by the formation of the Reservoir are complex and difficult, equally so are those of judicious exploitation. From time immemorial our inland fishermen have never fished deep and perennial lakes. Their methods and implements are poor and suited only for fishing shallow or transient waters, especially when the rivers and tanks dry up in the hot weather. If a lake with a capacity of 93,500 million cubic feet and a depth of 165 feet is to be fished to maximum advantage, all known methods of fishing deep waters have to be introduced by the Department by demonstration and the nets perhaps even supplied by subvention. It is hoped that the Co-operative Society which has just been formed will form the nucleus of a scientifically organised agency for the fishing and marketing of the produce of the lake.

To prevent the advent of large capitalists who are apt to monopolise the profits to the detriment of the actual workers, it has been decided to license coracles and tackle and not to auction the fishery.

The system of licensing will, it is hoped, enable a closer control of these new and great fisheries in the early years, help the Department in educating the fishermen individually and through the medium of Co-operative Societies in improved methods of

fishing and wean them from the clutches of middlemen. In fact, no other method suggests itself if this new and valuable fishery is to confer lasting benefit on both the producers, the Government and the fishermen on the one hand, and the large body of the fish-eating public on the other hand. As the fish-population of the lake increases with scientific care and control and as the catches increase with improved methods of exploitation, an ever-increasing circle of markets for miles around the lake will receive an unfailing and abundant supply of fresh food-fish now practically unknown.

B. SUNDARA RAJ.

The Journal of the Indian Anthropological Institute

WE offer our hearty welcome to this new *Journal* which meets a long-felt want in this country. While the scope for Anthropology is very vast in India, anthropological studies are still in their infancy, and periodicals for the publication of specialist information have been scarce. The new *Journal* therefore provides a much needed forum for Indian anthropologists, and as the official organ of the Indian Anthropological Institute, its position is unique and authoritative.

In the Foreword to the first volume the editor, Dr. B. S. Guha, who is also the Secretary of the Indian Anthropological Institute, explains the objects of the Institute and the *Journal*. While the importance of anthropology among the various social sciences is being realised in an increasing measure by all men interested in the social relations of sciences, and every enlightened savant recognises anthropology as the starting point in all considerations of sociological problems, systematic study of anthropology in India has, according to Dr. Guha, suffered a set-back since the Government of India and the various Provincial Governments discontinued the work of the Ethnographic Survey. Recently, there has been a resurrection of the old interest, especially in university circles, the Universities of Calcutta, Bombay and Lucknow having included courses in anthropology in their curricula. (Incidentally, Madras is the only one among the three oldest Universities that has been merely contemplating a department for anthropology for over a decade without any tangible result.)

The leading article of the issue is the Presidential Address to the Institute by Prof. J. H. Hutton, Head of the Department of Archæology and Anthropology in the Cambridge University. After recounting the difficulties in the way of organising anthropological work in India Dr. Hutton says: "....These very difficulties that beset your work in themselves render it all the more imperative that you should undertake it, for I believe that the science of Anthropology can do more than any other branch of study to resolve into a homogeneous unit the racial, cultural and temperamental diversities inevitable in the inhabitants of so great an area and such varying environments."

As urgent problems calling for investigation, Dr. Hutton suggests (1) the linguistic survey of the region south of the Godavari; (2) the study of the effect of climate, diet, etc., on the human subject; (3) an examination of the validity of the belief in inherited aptitude (India with her caste system is a unique field for this piece of research, but the study ought to be undertaken before the caste system is too much weakened); and (4) the correlation of palæolithic chronologies. Dr. Hutton makes a passionate appeal for the preservation in museums of the mass of ethnographic material while they are still available for collection. "Men trained in

museum technique," he says, "are badly needed for this purpose, but like so many other requirements can be had only if funds for their training can be found. A regular campaign is needed to persuade the wealthy to give freely for the purpose of ensuring that the rich inheritance of this generation from the past shall not perish in India for want of men trained to preserve it".

The second article on "Pre- and Proto-Historic Archæology in India," by Lt.-Col. D. H. Gordon is a harsh but not unconsidered evaluation of archæological studies in general. According to Col. Gordon, it is futile to expect Europeans and expeditions financed by them to take any sustained interest in Indian archæology for the simple reason that this country is not the land of the Bible. Though this writer's criticism of the work of scholars like Marshall, Mackay, Kramrisch, Stern and others, may sound Cassandra-like, it is an earnest and frank attempt of a good field-worker to diagnose some common scholastic diseases.

In the next article Mr. J. P. Mills describes the beliefs about *apotia* or accidental death among the *Lhota Nagas*. Other articles in the volume before us are "Anthropology in India and Ethnical Position of Indians" by Col. Germano da Silva Correia, "Indian Oil-Presses and Oil Extraction" by Prof. K. P. Chattopadhyay, "A Proposed Correlation of the Nasal Elevation Index" by Mr. S. S. Sarakar, and "Fishhooks in North America and their Distribution" by Dr. B. Bonnerjea.

A. A.

Tuberculosis in India

THE *Indian Medical Gazette* has for the third year in succession published a special tuberculosis number. The editor, Dr. L. E. Napier, sums up the reasons for this departure from the usual practice of the *Gazette*, which is a journal for the general practitioner in India and in no sense a specialist journal. He points out that a special effort is being made by the whole nation to tackle the tuberculosis problem and he feels that everyone should join in and support Lady Linlithgow's movement. The second reason is to show the practitioner in India what is being done, both in this country and abroad, for the tuberculous patient, to impress upon him that a very great deal can be done and that practically no case is hopeless, so that he in turn will pass on the information and will counteract a spirit of hopelessness which would be fatal to the movement.

He writes, "A perhaps not unnatural reaction to the enthusiasm of the early days of the launching of the appeal is now appearing and the people who helped to raise the fund are asking how the problem is going to be tackled, some in an interested and helpful spirit, others querulously and with a suggestion of hopelessness. 'What is the good', the latter say, 'of pointing to the successful campaigns in other countries, countries that are able and prepared to spend hundreds of pounds per tuberculosis death on sanatoria and tuberculosis hospitals, when we cannot afford as many pice for this special purpose?' But we shall not tackle the problem on the lines that they are doing it in Western countries and we should not do so even if we had the necessary resources; we shall devise means suited not only to our limited resources but to the special conditions of the country. Whilst the balance is certainly in favour of the richer Western countries, we have some factors that work in our favour, the sun, for example, and the relatively small proportion of our children that live under the conditions comparable to those of

the grinding poverty and squalor of the overcrowded, sunless slums of many large European cities."

He continues, "The control of the disease is so closely associated with the treatment of the existing cases that one cannot dissociate the two ideas. The anti-tuberculosis programme will of course include the building of sanatoria, up-to-date and well-equipped dispensaries, and after-care settlements, to act as models and to show what can be achieved under the most favourable conditions, but in such institutions, as with the funds available we could hope to found, scarcely one per cent. of our patients could be accommodated, and we shall certainly not be content to leave matters there: something must be done for the remaining 99 per cent., and tuberculosis dispensaries, conducted on more modest, but still we hope up-to-date lines, will have to be established, not only in every province and district but eventually in every *thana* or *taluk* in the country."

The third reason for the publication of these special numbers is that the services of a special Editorial Committee of the Tuberculosis Association of India were offered; this Committee collected a number of important papers from the leading tuberculosis workers in India, and the special Tuberculosis Number consists of a valuable collection of articles which form an important contribution to the science of phthisiology as applicable in Eastern and Tropical countries.

There is an important article by Professor Lyle Cummins, one of the leading authorities in Great Britain and one who has made a special study of tuberculosis under tropical conditions. He points out that, in many of the populations which are being attacked in India, tuberculosis is a comparatively new experience and therefore it takes on a particularly virulent form.

Dr. Frimodt Moller has written a very practical and important article on the designing of dispensaries and sanatoria; detailed plans are reproduced.

The extreme seriousness of the tuberculosis problem in India is brought out by a survey that has been carried out near Madras by Dr. Benjamin and his co-workers. He estimates that about one in every forty persons in this town is suffering from active tuberculosis and requires immediate treatment.

There are some very useful clinical articles by Dr. A. C. Ukil, K. N. De, and P. K. Sen.

There is an important contribution on the surgical treatment of tuberculosis by Dr. W. M. G. Jones, Superintendent of the Wanless Tuberculosis Sanatorium. This form of treatment has assumed considerable importance in Europe and America during the last few years and it constitutes the greatest advance in treatment, especially in the type of case that a few years ago was considered hopeless.

This Special Number will be very much appreciated by medical men in India and we believe that it will do much to stir up interest in this very important subject and to provide encouragement for the tuberculous and those who are attempting to help them.

Isotopes and Hyperfine Structure

(A Brief Review)

By L. Sibaiya, M.Sc.

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THE existence of hyperfine structure in spectral lines was first discovered by Michelson[1] employing an indirect but ingenious method of visibility measurements on his interferometer. This method has since been superseded by more direct methods of analysis, which require such high resolving power instruments as Fabry-Perot etalons, Lummer-Gehrcke plates, echelon spectroscopes and concave gratings. Analysis of spectral lines led only to an accumulation of observational data and the origin of hyperfine structure remained obscure till 1924. It was in this year that Pauli[2] suggested that the structure is to be attributed to a small magnetic moment associated with the spinning nucleus. Measurements of the intensities of the components soon revealed that in addition to this effect the different isotopes of the element were in many cases responsible for additional complications in the hyperfine structure patterns. It has been since found that the isotope with the nuclear spin moment is invariably an odd isotope and depending on the magnitude of the magnetic moment a wide or narrow structure is displayed. All the components arising from even isotopes on the other hand are sometimes grouped together in one intense line or in some instances appear separately at approximately equal intervals. Spectral lines of both these types often occur in the spectrum of the same element. Thus the hyperfine structure of a spectral line is intimately connected with the isotopic constitution of the element; while the even isotopes contribute at best a single component for each isotope, the odd isotopes in virtue of their mechanical and magnetic moments give rise to a larger number of components. An additional fact of importance is that the total intensity of the components arising from any given isotope is strictly proportional to its abundance. The centre of gravity of the components due to an odd isotope either falls in between the nearest even isotopes or coincides with the main line when there is no even isotope separation. Thus the elements in the Periodic Table can be classified into groups which contain only odd isotopes and display spin structure or those which consist of both odd and even isotopes and yield a structure with or without even isotope displacement. A brief review of the available results obtained from a study of the hyperfine structure of spectral lines in relation to the isotopic constitution of the elements is given below.

Elements with only ODD isotopes.—Elements with odd atomic number generally have either one or two odd isotopes. In the case of those elements which have only one odd isotope the hyperfine structure, if any, arises from a nuclear spin; there can obviously be no isotope structure. When the element contains two odd isotopes, they can have the same or different mechanical or magnetic moments and may display an isotope shift in some levels. Table I gives the known values of mechanical and magnetic moments of the odd isotopes of the odd atomic number elements and wherever two values are given they refer respectively to the two isotopes of the element.

TABLE I

Atomic number	Element	Isotopes	Nuclear spin moment	Magnetic moment in proton magnetons
(1	H	1, 2	1/2, 1 Band spectrum	2·5, 0·85
3	Li	6, 7	1, 3/2	0·85, 3·3
5	B	10, 11	.., 3/2	0·597, 2·682
7	N	14	1	0·402)
9	F	19	1/2	2·64
11	Na	23	3/2	2·0
13	Al	27	5/2	~3·7
15	P	31	1/2 (B.S.)	..
17	Cl	35, 37	5/2?, ?	<0·3

[1] *Phil. Mag.*, 1891, **31**, 338.

[2] *Naturwiss.*, 1924, **12**, 741.

TABLE I—*(Contd.)*

Atomic number	Element	Isotopes	Nuclear spin moment	Magnetic moment in proton magnetons
19	K	39, 41	3/2	0·36, 0·20
21	Sc	45	7/2	4·6
23	V	51	7/2	..
25	Mn	55	5/2	..
27	Co	59	7/2	~2·5
29	Cu	63, 65	3/2	2·5, 2·6
31	Ga	69, 71	3/2	2·0, 2·5
33	As	75	3/2	1·5
35	Br	79, 81	3/2	2·6
37	Rb	85, 87	5/2, 3/2	1·3, 2·6
39	Y	89	1/2?	..
41	Nb	93	9/2	3·7
45	Rh	103	1/2 ?	..
47	Ag	107, 109	1/2	−0·1, −0·2
49	In	115	9/2	5·3
51	Sb	121, 123	5/2, 7/2	3·7, 2·8
53	I	127	5/2	~3
55	Cs	133	7/2	2·5
57	La	139	7/2	2·8
59	Pr	141	5/2	..
63	Eu	151, 153	5/2	3·4, 1·5
65	Tb	159	3/2	..
67	Ho	165	7/2	..
69	Tu	169	1/2	..
71	Cp	175	7/2	2·6
73	Ta	181	7/2	..
75	Re	185, 187	5/2	3·3
77	Ir	191, 193	1/2, 3/2	..
79	Au	197	3/2	0·2
81	Tl	203, 205	1/2	1·45
83	Bi	209	9/2	3·6

The above table shows that the hyperfine structure study of the spectral lines from elements of odd atomic number is fairly complete.

Elements of even atomic number.—A number of odd and even isotopes are usually grouped together in each element of even atomic number. Of these isotopes those with even mass number have not given any evidence of spin structure, which only means that their nuclear magnetic moments are invariably zero or negligibly small. The hyperfine structure methods are inherently unable to distinguish between zero spin and zero magnetic moment; hence the even isotopes are generally assumed to possess no nuclear spin moment. Despite the fact that no spin structure is in evidence due to the even isotopes, they often give rise to separate components so that each even isotope is individually represented in the hyperfine structure pattern. In such cases the agreement in the relative intensities of the components with the known even isotopic constitution of the element is the criterion for assuming the existence of the isotope shift. The spacing of the components will generally be fairly equal for equal difference in mass numbers. The only known exception of this empirical rule is found in samarium where the separation of the isotopes Sm^{150} and Sm^{152} is twice as large as that of the isotopes Sm^{152} and Sm^{154}; this difference has been traced to an entirely alien factor connected with the α-activity of samarium. With regard to the odd isotopes of these even atomic number elements they display a spin structure whose centre of gravity lies between the two consecutive even isotopes on either side; again it is a matter of observation that the centre of gravity of the odd isotope lies nearer to the lighter even isotope. When there is no even isotope separation, the most intense component usually represents the superposition of all the components arising from the various even isotopes and the centre of gravity of the odd isotope patterns coincides with the main line. Table II gives the mechanical and magnetic moments of the odd isotopes of elements with even atomic number and indicates that the study of such elements is far from complete.

Spin structure.—With the introduction of a nuclear spin quantum number I a given gross multiplet level of an atom with its inner quantum number J splits into a tiny hyperfine multiplet whose component levels are characterised by the fine quantum numbers F, which can take all values from I + J to I ~ J. The resulting number of hyperfine

TABLE II

Atomic number	Element	Odd isotopes	Nuclear spin moment	Magnetic moment
30	Zn	67	5/2	0·9
32	Ge	73	..	~0
34	Se	77	1/2 ?	~0
36	Kr	83	9/2 ?	−1·0
38	Sr	87	9/2	−1·1
42	Mo	93, 95	1/2	..
46	Pd	105	1/2 ?	~0
48	Cd	111, 113	1/2	−0·65
50	Sn	115, 117 119, 121	1/2	−0·9
54	Xe	129, 131	1/2, 3/2	−0·8, 0·7
56	Ba	135, 137	3/2	0·9
62	Sm	147, 149	..	..
70	Yb	171, 173	1/2, 5/2	..
78	Pt	195	1/2	0·6
80	Hg	199, 201	1/2, 3/2	0·5, −0·6
82	Pb	207	1/2	0·6

levels becomes $2I+1$ or $2J+1$ according as $I \leqslant J$ or $J \leqslant I$. On the vector model of the atom the interaction energy of the nuclear magnet in the magnetic field due to the extranuclear electrons is given by

$$E = a\ IJ\cos(IJ)$$
$$= \tfrac{1}{2}a\ [F(F+1) - I(I+1) - J(J+1)]$$
$$= \tfrac{1}{2}aC$$

after embodying the quantum mechanical corrections. The energy difference between two consecutive hyperfine structure levels with fine quantum numbers F and $F+1$ is

$$\Delta E = a(F+1),$$

which shows that the Lande interval rule should be applicable quite rigidly in the case of hyperfine levels. Careful measurements have recently revealed in some elements minute departures from the Lande interval rule indicating thereby a want of spherical symmetry in the nuclear charge distribution. The deviations therefore have been traced by Casimir[3] to an electric quadrupole moment for the nucleus. The interaction energy levels are then given by

$$E = \tfrac{1}{2}aC + bC(C+1),$$

where a and b are the interval rule and quadrupole interaction constants respectively. Computations based on Casimir's formulæ give for the nuclei the quadrupole moments as mentioned in Table III, where the positive sign indicates that the charge distribution in the nucleus is elongated along the spin axis and the negative sign means an oblate spheroidal distribution of charge.

TABLE III

Atomic number	Element	Isotope	Quadrupole moment $q \times 10^{24}$ cm.^{2}
29	Cu	63, 65	−0·1
31	Ga	69, 71	+1·0, 0 ± 0·5
33	As	75	+0·3
36	Kr	83	+0·04
49	In	115	+0·84
54	Xe	131	⩽ 0·03
63	Eu	151, 153	+1·2, +2·5
71	Cp	175	+5·9
75	Re	185, 187	+2·6
80	Hg	201	+0.5
83	Bi	209	−0·4

Transition between two sets of hyperfine levels occurs such that $\Delta F = 0$ or ± 1 without exception and the relative intensities of the hyperfine components can be computed from the intensity rules rederived on the quantum mechanics by Dirac[4] with suitable modifications for the case of hyperfine structure. Forbidden transitions in hyperfine structure have not so far been observed.

Isotope structure.—The isotope displacement to be expected on the basis of a variation in the Rydberg constant from isotope to isotope on the basis of the Bohr theory is obtained in the case of hydrogen isotopes H^1 and H^2. If the isotope shift in such cases arises solely from a change in the nuclear mass, the wave-number shift can be computed from $\Delta\nu = \nu\,\Delta M/1838M^2$, where M is the mean value of the mass numbers of the two isotopes and ΔM their difference. Even the isotope separation in argon lines indicates that with the exception of $1s_2$ term the displacements of the other terms can be

[3] *Physica*, 1935, **2**, 719.

[4] *Proc. Roy. Soc.* (A), 1926, **111**, 281.

explained on the previous considerations.[5] But in the case of heavy elements like Pt, Hg, Tl, etc., the observed isotope displacements are too large and several attempts have been made to account for it. Postulates such as the deviation of the nuclear electric field from being Coulombian or the variation in the inherent structure of the nuclei with the consequent changes of size and shape from isotope to isotope have been tried. With Goudsmit's extension of Lande's formula for $(\overline{1/r^3})$ where r is the nuclear radius, Breit has found it possible to explain the order of magnitude of the isotope displacements in Hg, Tl and Pb lines on the hypothesis of small changes in nuclear radii. Breit's theory[6] of isotope shift indicates in general that the greatest isotope displacements are to be expected in levels involving two tightly bound s-electrons like $5d^4\ 6s^2$. Experimental data for the isotope shifts in the spectroscopic levels of many elements are now available and await a more complete theoretical interpretation. Table IV gives the electron configurations for which the isotope shifts have been observed as well as the mean magnitude of this shift for a change of two units in the isotope mass; the positive sign denotes that the heavier of the two isotopes lies deeper.

TABLE IV

Atomic number	Element	Electron configurations and terms for which isotope displacements are observed	Mean value of isotope shift for $\Delta M = 2$, in cm.$^{-1}$
1	Ne	Terms : 1s	+0·107
		2p	+0·048
		2s	+0·040
		3d	+0·032
12	Mg	3^1P	+0·056
		n^1D	$-0\cdot240/n^2$?
17	Cl	Cl II $4s\ ^5S_2$	−0·035
18	A	1s	−0·025
		2p	−0·015
		3p	−0·008
29	Cu	$3d^9\ 4s^2\ ^2D_{3/2}$	+0·073
		$3d^9\ 4s^2\ ^2D_{4/2}$	+0·085
30	Zn	Zn II $3d^9\ 4s^2\ ^2D_{3/2,\ 4/2}$	+0·094
35	Br	$5p\ ^4D_{7/2}$	+0·007 ?
42	Mo	$4d^4\ 5s^2\ D_{01234}$	−0·015 ?
48	Cd	Cd II $4d^9\ 5s^2\ ^2D_{3/2,\ 5/2}$	−0·051
50	Sn	$5d\ ^2D_{3/2}$	0·020 ?
62	Sm	..	0·060
74	W	$5d^4\ 6s^2\ ^5D$	−·052
75	Re	$5d^5\ 6s^2\ ^6S_{5/2}$	−0·064 ?
76	Os	$5d^6\ 6s^2\ ^5D_4$	−0·065
77	Ir	$5d^8\ 6s\ ^4F_{9/2}$?	+0·057
78	Pt	$5d^9\ 6s\ ^3D_3$	−0·082
		$^3D_2$	−0·117
		$^3D_1$	−0·090
		$^1D_2$	−0·123
		$5d^8\ 6s^2\ ^3F$	−0·203
		$5d^8\ 6s\ 6p\ ^5D_4, {}^5G, {}^5F_5$	−0·110
80	Hg	Hg I $5d^9\ 6s^2\ 6p^1p_1$	−0·150
		$5d^{10}\ 6s^2\ ^1S_0$	−0·165
		$5d^{10}\ 6s\ 7s\ ^1S_0$	−0·030
		$5d^{10}\ 7s\ ^3S_1$	−0·030
		$5d^{10}\ 6s\ 8s\ ^3S_1$	−0·020
		Hg II $5d^9\ 6s^2\ ^2D_{5/2}$	−0·500
		$5d^9\ 6s\ 6p\ ^2D_{5/2}$	−0·680
81	Tl	Tl I $5d^{10}\ 6s^2 6p\ ^2P_{3/2}$	+0·055
		$5d^{10}\ 6s^2 6p\ 2P_{1/2}$	+0·060
		Tl II $5d^9\ 6s^2\ ^1P_1$	−0·290
82	Pb	Pb I $6s^2\ 6p^2\ ^1S_0$	+0·068
		$6s^2\ 6p^2\ ^1D_2$	+0·086
		$6s^2\ 6p^2\ ^3P_2$	+0·090
		$6s^2\ 6p^2\ ^3P_1$	+0·085
		$6s^2\ 6p^2\ ^3P_0$	+0·083
		$6s^2\ 6p\ 6d\ ^3D, {}^3F$	+0·030
		Pb II $6s\ 6p^2\ ^2D_{5/2}$	+0·288
		$6s\ 6p^2\ ^2D_{3/2}$	+0·434
		$6s^2\ 6d\ ^2D_{5/2}$	+0·205
		$6s^2\ 6d\ ^2D_{3/2}$	+0·089
		Pb III $6s^2$?	+0·300

The alteration in the sign of the isotope displacements from the arc to the spark spectrum as in thallium along with the random variation of the shift and its sign even in the same electronic configuration like $d^9\ s^2$ of elements such as copper, zinc, cadmium and mercury invalidates the general applicability of Breit's theoretical considerations. The solution of the problem of isotope displacement is therefore considered to be in an unsatisfactory stage and it is hoped that it will soon receive the attention it deserves at the hands of the theoretical physicist.

[5] Kopfermann and Kruger, *Zeits. f. Physik*, 1937, **105**, 389.

[6] *Phys. Rev.*, 1932, **42**, 348.

LETTERS TO THE EDITOR

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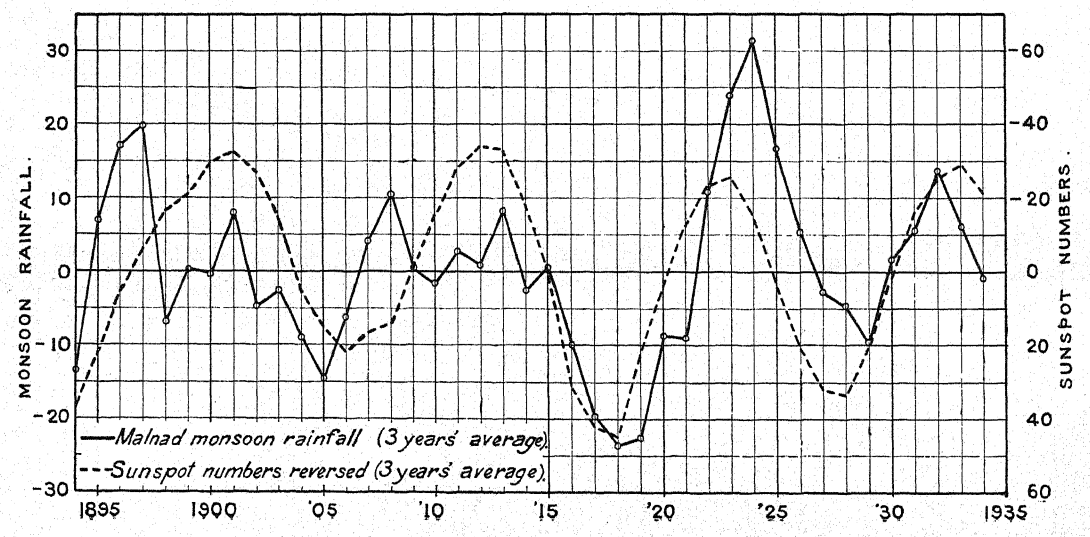
Sunspots and Mysore Rainfall

In trying to improve the regression formula for Mysore rainfall given in *Current Science*, April 1938, it was found that sunspot numbers would serve as a useful factor for foreshadowing the Malnad rain. The average rainfall for the Malnad area during the monsoon season, June to September, is 85″ based on the average of the nine Taluk stations, Sagar, Hosanagar, Thirthahalli, Sorab, Sringeri, Koppa, Mudigere, Narasimharajapura and Saklespur, for the years 1893 to 1935. The coefficient of correlation between the annual sunspot number and the monsoon rainfall of the Malnad in the same year is $-\cdot38 \pm \cdot09$; the coefficient with the monsoon rainfall of the preceding year is $-\cdot26 \pm \cdot10$, and that with the monsoon rainfall of the following year is $-\cdot35 \pm \cdot09$. If we use three-year averages instead of individual year's data the contemporary coefficient between sunspot number and Malnad rain increases to $-\cdot50 \pm \cdot08$. Curves showing the three-year averages of Malnad rain and sunspot number reversed are shown in the figure below.



The opposition between Malnad rain and sunspot number is more clearly shown if we consider the years of sunspot maxima and minima. The best method of bringing out the relation seems to be to consider the average figures for three years at sunspot maximum and at sunspot minimum. Since 1893 there have been five sunspot maxima and four sunspot minima. For the epochs of sunspot maxima and minima, the sunspot numbers and the departures from normal of monsoon rainfall in the Malnad for the years preceding, contemporary with and succeeding the year of sunspot maxima or minima are given in Table I; the mean of the departures for the three years is also given in the last column. This table shows that on the average of the three years sunspot maxima were associated with deficient rains and sunspot minima with excess rain. The year 1923, one of the years of sunspot minimum was the wettest year on record for the Malnad.

Similar data for the monsoon rainfall in the Maidan region of Mysore are given in Table II. They do not indicate any relation between sunspot number and Maidan rainfall, a fact confirmed by the insignificant correlation coefficient between the two.

TABLE I

Sunspots and Malnad Monsoon Rain

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	1·2	−16·2	−13·9	−6·9
1905	63	0·3	−27·6	−16·4	−14·6
1917	104	−1·5	−11·9	−45·5	−19·6
1928	78	0·9	−15·1	0·9	−4·4
1937	115	−8·7	−10·3	−11·9	−10·3
		Sunspot Minima			
1901	2·7	37·8	−5·1	−8·1	8·2
1913	1·4	16·1	−10·3	18·8	8·2
1923	5·8	−14·2	50·3	35·2	23·8
1933	5·6	12·8	9·9	−4·2	6·2

TABLE II

Sunspots and Maidan Monsoon Rain

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	2·5	−1·0	−4·0	−0·8
1905	63	−3·8	−4·3	4·9	−1·1
1917	104	3·8	5·0	−5·8	1·0
1928	78	0·8	−2·9	−1·3	−1·1
1937	115	2·7	−1·4	6·2	2·5
		Sunspot Minima			
1901	2·7	0·4	−1·9	−2·6	−1·4
1913	1·4	4·4	0·6	−2·9	0·7
1923	5·8	−5·2	−0·5	3·1	−0·9
1933	5·6	1·4	3·5	−6·0	−0·4

Table III gives similar data of rainfall departures for the whole of the Mysore State for the whole year. Taking the average of the three years the departures are positive in all the four occasions of sunspot minima, and negative in four out of five occasions of sunspot maxima; but the departures are not high.

TABLE III

Sunspots and Mysore Annual Rainfall

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same Year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	−2·3	4·9	−2·9	−0·1
1905	63	−2·8	−6·8	3·8	−1·9
1917	104	11·7	5·3	−8·2	2·9
1928	78	−4·5	−0·3	3·2	−0·5
1937	115	−0·9	−2·2	−5·0	−2·7
		Sunspot Minima			
1901	2·7	3·3	3·3	2·4	3·0
1913	1·4	9·6	−2·6	0·2	2·4
1923	5·8	−1·9	−0·3	4·4	0·7
1933	5·6	12·3	12·5	−6·9	6·0

The foregoing analysis indicates that it is only in the Malnad region that there is a fairly marked association between sunspots and rainfall. It may be stated in a general way for this region that in years of maximum sunspots there is likely to be deficient monsoon rain and in years of minimum sunspots an excess of monsoon rainfall.

If there was a strict regularity about the sunspot cycle, and the maxima recurred at regular intervals of 11 years, we would have an extremely valuable indication, well in advance, of years of deficient monsoon rainfall in the Malnad. But as H. T. Stetson has pointed out in his book, *Sunspots and Their Effects*, although the average interval from one sunspot maximum to the next is 11·13 years, the interval has sometimes been as long as 16 years, and sometimes as short as 8 years.

If we include the correlation coefficient of − ·35 between the sunspot number and the Malnad monsoon rainfall of the following year, in the regression formula for Malnad rain given in *Current Science*, April 1938, the multiple correlation coefficient increases from ·52 to ·60, the increase being significant.

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October 2, 1939.

Scanning of the Hysteresis Loop in Sorption

BY the extensive work of Allmand and collaborators,[1] Lambert[3] and Foster,[2] the phenomenon of "Hysteresis in Sorption" was established as real. The exact cause of the phenomenon has yet been a matter of controversy and it has been explained by investigators from various points of view. During recent times, the explanation based on the concept of cavities having narrow necks,[4] seems to be gaining support. With a view to elucidate the exact cause of this phenomenon, the hysteresis loop obtained in the sorption of water on titania gel has been scanned, by traversing the loop from various intermediate points on the sorption and desorption curves. The scanning of hysteresis loop has revealed certain characteristics which form a convincing proof of the cavity concept, as a general cause of hysteresis.

Sorption and desorption of water vapour at 30° C. were conducted on titania gel activated at 300° C. and degassed in vacuum for five hours. The quartz fibre spring technique was employed in the work. The system exhibits hysteresis, the reproducibility of which is remarkable unlike rice-water system.[5] The hysteresis loop has been traced after thirty sorptions and desorptions. The loop has been scanned by trying sorption and desorption at various points on the desorption and sorption curves respectively, forming the hysteresis loop (Fig. 1). If desorption is effected at any intermediate point on the sorption curve, the loop is crossed and the desorption curve is reached. The course followed on effecting sorption, starting from any intermediate point on the desorption curve is, however, different. Instead of the sorption curve being reached, the

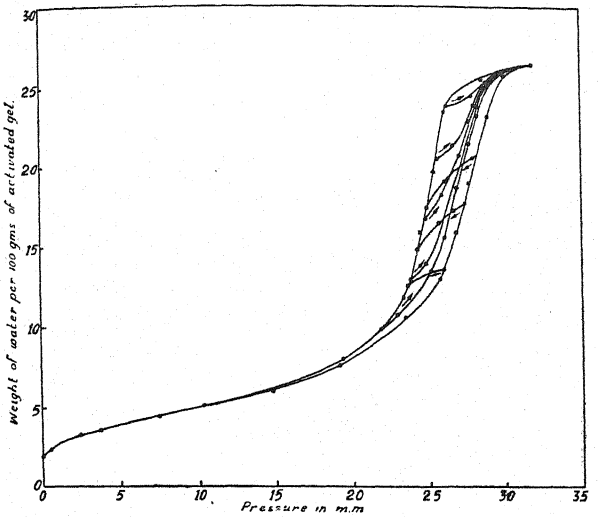

FIG. 1

path traces an independent curve till it reaches the peak of the hysteresis loop. In these experiments, the starting points on the sorption and desorption curves were reached from the zero and the saturation pressures respectively.

These significant observations are satisfactorily explainable only on the basis of the cavity concept. In the porous titania gel, there are capillaries of varying shapes and dimensions. Some of them are V-shaped pores and some are cavities having narrow necks, the latter alone being responsible for the hysteresis effect. During sorption these cavities are filled up in the same way as the V-shaped pores. During desorption, however, they get emptied only when they are exposed to pressures below the minimum at which water condensed in the necks of the cavities will just be in equilibrium with the vapour. At any point along the sorption curve forming the hysteresis loop there are always some cavities filled with water. When desorption is effected some of the water is entrapped and consequently the hysteresis loop is crossed till the main desorption curve is reached. At points along the desorption curve, there are some of the bigger cavities yet unemptied. When sorption is tried at these points separate curves are traced in juxtaposition to the main sorption curve and all these curves reach the peak of the hysteresis loop.

In another investigation on the scanning of the hysteresis loop obtained in the sorption of water on silica gel, exactly similar results have been obtained. The results on the scanning of the hysteresis loop definitely prove that a cavity completely filled with the liquid is emptied only when it is exposed to a pressure less than what is just sufficient for water in the neck of the cavity to be in equilibrium with the vapour, whereas the hysteresis loop itself can be caused even by a slight lowering from the minimum pressure which is enough to completely fill the cavity with the liquid. If a cavity has two or more necks of different dimensions, it is the largest neck that determines the pressure at which the emptying of the cavity takes place. It follows from the cavity concept that the true equilibrium curve is the sorption curve because along the desorption curve, the cavities retain the liquid in a metastable equilibrium and that the hysteresis effect in all porous adsorbents must be a rule rather than an exception. One of the causes, however, for the nonexistence or the disappearance of the hysteresis effect has been shown to be the elasticity of the cavity wall.[5]

KITTUR SUBBA RAO.

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Central College,
Bangalore,
September 29, 1939.

[1] Allmand, Hand and Maning, *J. Phys. Chem.*, 1929, **33**, 1694.
[2] Foster, *Proc. Roy. Soc.* (Lond.), 1934, **146A**, 129.
[3] Lambert and Foster, *Ibid.*, 1932, **136A**, 363.
[4] McBain, *J. Amer. Chem. Soc.*, 1935, **57**, 699.
[5] Rao, *Curr. Sci.*, 1939, **8**, 256.

Alleged Optical Isomerism of 6-Co-ordinated Cupric Salts

IN general, cupric ion does not form 6-co-ordinated compounds and readily stops at four. In 1927 Wahl[1] claimed to have prepared a lævorotatory diaquo bis ethylene diamino cupric iodide $[Cu\ en_2\ (H_2O)_2]I_2$. It is obvious that a cation $Cu(en)_2$ would be inactive and it is

only the formation of a 6-co-ordinated complex by means of two water molecules that could make the activity possible. Further, the complex must have to be remarkably stable: if the latter were even partially dissociated off in solution, the compound would racemise. Johnson and Bryant[2] on reinvestigation found that Wahl's iodide dihydrate effloresces in air and the constitution of the complex ion in the crystal is $[Cu(en)_2]++$, the co-ordination valency being four, not six. Optical isomerism is therefore excluded. The authors state that the ion $[Cu\ en_2(H_2O)]++$ even if formed in aqueous solution, is too unstable to permit of resolution. The present observation is in agreement with this remark in so far as the analogy between the structures $[Cu\ en_2-(H_2O)_2]I_2$ and $[Cu\ pn_2\ (H_2O)_2]I_2$ may be regarded as relevant. It has been found that in diaquo bis propylene diamino cupric iodide, one molecule of water is very loosely held and the crystals of the diaquo compound rapidly lose their lustre and form the monohydrate. A 6-co-ordinated cupric ion, therefore, does not exist in the solid state and the presence of octahedral configuration cannot be said to have been established in the case of copper by optical resolution.

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Presidency College,
Calcutta,
October 6, 1939.

[1] *Soc. Sci. Fenn. Phy. Math.*, 1927, **4**, 14.
[2] *J. C. S.*, 1934, 1783.

Twig Blight and Fruit Rot of Mango

IN Bombay mango trees become affected in the monsoon by a disease producing on the twigs water-soaked areas, which rapidly enlarge in extent. Invariably there is a rapid upward extension of the invaded region, and the lateral spread is quite limited in extent and never girdles the twig. The affected bark ultimately turns dark brown, and the shoot dries up (Fig. 1). Numerous dark brown pycnidia are formed at the margin of the invaded region of the bark, but in the affected area their number is small. They measure from 88 to 248 μ in diameter (56·8 to 145·5 μ in culture) and have an ostiole, which perforates the epidermis. The hyaline pycnospores measure 16·5 to 26·1 by 4·8 to 6·9 μ. The disease also affects the ripening fruit during storage and produces a black rot especially at the stalk-end of the fruit.

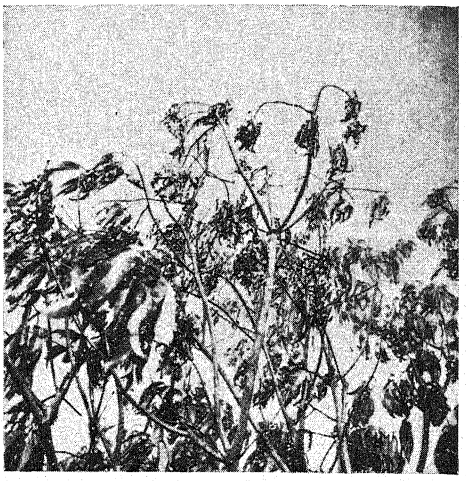

FIG. 1

Showing the drying up of twigs of mango trees due to infection with *Phoma* sp.

A species of *Phoma*, which is probably new to science, was readily isolated from the diseased bark and was also obtained from naturally infected mango fruits. Inoculation experiments on wounded stems with 3 to 4-week-old cultures of the fungus grown in potato-dextrose agar gave positive results. In inoculation experiments a vertical slit was made in the bark with a sharp knife, and bits of mycelium were applied to the cut surface and covered with paraffin or wrapped over with wet cotton wool. In about 72 hours water-soaked areas appeared round the slits, and infection spread more rapidly towards the apex of the twig than at the sides, ultimately killing the twig. Green twigs of *Pairi* and *Alphonso* varieties of mango between the ages of one and two years are highly susceptible to infection, whilst younger shoots and those with mature bark fail to take

infection. Twigs of country varieties are highly resistant.

Similar inoculation experiments were made with mango fruits which were slightly wounded near the stalk-end. Young inoculum was applied to these wounds, which were subsequently covered with paraffin or wet cotton wool. The inoculated fruits were incubated at 27° C. Typical black rot developed in the inoculated fruits within 72 hours. Inoculation experiments on wounded fruits further showed that infection develops more rapidly in *Pairi* than in *Alphonso* or other varieties of mango.

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On the Occurrence of *Apus* in Gujarat, Western India

Apus is an ancient genus of fresh-water Phyllopoda which occurs practically all over the world. It has been reported from some parts of India also[1]; but our knowledge of its distribution in this country is far from being complete. This is largely due to the fact that *Apus* with its archaic form is ill suited for migration from isolated muddy ponds in which it occurs during the monsoons. No sooner it appears than it disappears; it seldom lives for more than three weeks. Its distribution is, therefore, often erratic.

In the last August, while looking for plants of *Marsilea minuta* in some small sheets of water collected during rains in the vicinity of the Gujarat College, Ahmedabad, and some other places, I was able to collect a large number of fresh-water Crustacea which contained, *inter alia*, many specimens of *Apus*—presumably *cancriformis*—similar to those from Kashmir.[2] This was rather surprising as the only form of *Apus* known so far from peninsular India was *Apus asiaticus* reported by Gurney[3] from the famous Panchgani locality in the Bombay Presidency. The occurrence of another form of *Apus* in this Presidency, therefore, is a matter of considerable interest. Possibly, this is another piece of evidence in support of the belief in the African element in the fresh-water fauna of Western India. The reasons for such a view are obvious: *Apus cancriformis*, not distantly related to *Apus asiaticus*, occurs in Morocco, Cyrenaica, North Africa, Eritrea, Asia Minor, Kashmir, United Provinces[4] and some other places. It is unlikely, therefore, that it occurs in Gujarat (Western India) by mere chance.

A detailed statement in elucidation of this view based on a comparative study of *Apus asiaticus* and *Apus cancriformis* will be published elsewhere.

T. S. MAHABALÉ.

Department of Biology,
Gujarat College, Ahmedabad,
September 28, 1939.

[1] Kemp, *Rec. Ind. Mus.*, 1911, **6**, 353; Gurney, *Ibid.*, 1925, **27**, 439.

[2] Gurney, *loc. cit.*, p. 439.

[3] ———, *Ann. Mag. Nat. Hist.*, 1924, **14**, (9), 566 see also *loc. cit.*, p. 440.

[4] Walton, *Rec. Ind. Mus.*, 1911, **6**, 351.

A Note on the Development of the Female Gametophyte in Some Indian Compositæ

LITERATURE on the gametogenesis of the members of Compositæ is very extensive. Very little work in this direction has, however, been done in India. The investigations of Bhargava[1] on *Eclipta erecta* and Banerji[2] on *Carthamus tinctorius* could be mentioned only in this connection.

A comparative study of the development of the flower, pollen grains and embryology in *Mikania cordifolia*, *Launea asplenifolia* and *Blumea laciniata* is in progress since 1938. This note gives a general account of the development of the female gametophyte in the above-mentioned plants. A full account of the investigation will be published shortly elsewhere.

The archesporial cell is hypodermal in origin in all the three plants. It functions directly as the megaspore-mother cell. After the completion of the reduction division a linear tetrad

of megaspores is noted in every case. In no case was a "T-shaped" tetrad observed. The megaspores become deep-seated on account of the division of the 'cover' cells. The upper three megaspores degenerate and the chalazal one becomes functional. By three successive divisions it produces an eight-nucleate embryo-sac. The mature gametophyte is of the normal angiospermous type. The synergids have pointed ends and the polar fusion nucleus lies close to the egg. In *Mikania cordifolia* and *Blumea laciniata* the antipodal cells are each binucleate, whereas in *Launea asplenifolia* the antipodal cells are uni-nucleate.

The author expresses his thanks to Mr. I. Banerji under whose guidance the work is being carried out.

SUNIL DATTA.

Department of Botany,
Calcutta University,
October 5, 1939.

[1] Bhargava, *Proc. Ind. Acad. Sci.*, 1935, **1**, No. 7.

[2] Banerji, Paper read at the 25th session, *Ind. Sci. Cong.*, (in the press).

Teratological Notes

ABNORMALITIES have been recorded in the following plants:—

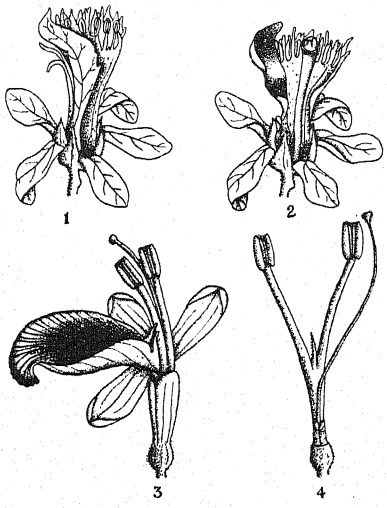
(1) *Melia azedarach* Linn.

(2) *Elettaria cardamomum* Maton.

(3) *Musa sapientum* Linn.

(1) In normal flowers of *Melia azedarach* Linn., the staminal tube is dark purple, a little shorter than the petals, cylindrical, slightly dilated and laciniate at the mouth; anthers 10, within the tube at the apex. But the specimen investigated shows that the staminal tube has gone a step further in dilatation and a major part of it has actually expanded and assumed the shape and colour of a petal, but much longer than it (Figs. 1 and 2). It is interesting because it serves as a good example of petalody.

(2) Normal flowers of *Elettaria cardamomum* Maton contain only one perfect stamen, that is, the dorsal stamen of the inner whorl is perfect, the other two combine in a petaliferous lip usually embracing the fertile stamen. The outer whorl is represented by two teeth-like staminodes. But the specimen under report, which is collected from the Botanic Garden, Osmania University, contains two perfect stamens instead of one which is characteristic of the Zingiberaceæ (Fig. 3). In this specimen the dorsal perfect stamen has bifurcated during



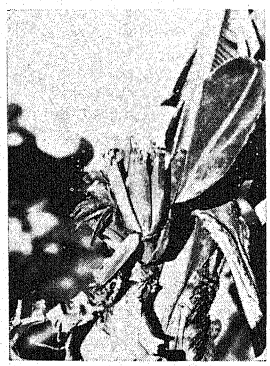


FIG. 1.—Flower of *Melia azedarach* Linn., showing the petaliferous staminal tube—dorsal view.

FIG. 2.—The same in ventral view.

FIG. 3.—Flower of *Elettaria cardamomum* Maton, with two stamens.

FIG. 4.—Bifurcated stamen with two arms bearing perfect anthers.

FIG. 5.—Photograph of *Musa sapientum* Linn., showing the abnormal inflorescence with female flowers only.

development, and the two arms of the filament bear two perfect anthers (Fig. 4).

(3) An interesting inflorescence of *Musa sapientum* Linn. has been observed in a plant growing in the house of one of us (Fig. 5). It is quite different from the abnormal inflorescences of this plant described by several workers like Dr. K. Biswas, Messrs. K. G. Banergee and G. P. Mozumdar. The specimen under discussion is interesting because the spike could not come out of the sheathing leaf-bases and the scape could not elongate. The inflorescence is a condensed spike, bursting out from the base of the crown of leaves as reported by Mr. S. C. Banergee. The flowers are all female, and due to their close aggregation the fruits could not attain their normal size.

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September 20, 1939.

Occurrence of *Cestum amphitrites* (Mertens) on the Madras Coast

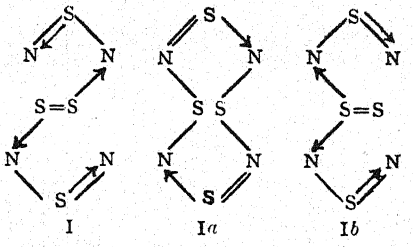
A beautiful specimen of this Cestoid Ctenophore was taken at 9 a.m. on the 15th August swimming gracefully at the surface of the sea, a couple of miles off the Senate House, Madras. At the time of capture a strong coastal current was flowing southwards. The specimen was in good condition when brought to the laboratory and moved with a slow serpentine movement and lived for more than three hours giving enough time for comparison with the description of the species given by Bigelow[1] from the Maldive Islands (1904, 1912). The ctenophore is nearly 25 mm. broad and about 210 mm. long. The body is flattened and tapers gradually towards the extremities. In a cross-section the body would appear rectangular since the oral side is as broad as the aboral side. Along the aboral side the ciliary bands extend from near the apical sense organ to the extremity of the band-like body on either side. No such ciliary bands are present along the oral edge of the animal. Instead this side is marked by a narrow groove flanked on either side by a low narrow ridge running from the centre towards the extremities. The stomach was perfectly transparent and no food could be detected in it. The vibratile combs are not prominent and some had ceased to act. The rather stout cilia of the two long aboral ciliary bands work actively. Along this aboral edge particularly, the animal is characterised by a peculiar iridescence. But the most important feature is the presence of two beautiful orange patches one at either end of the band-shaped body. I am not aware of any record of this beautiful form from the east coast of India. Preservation of the animal with Lo Bianco mixture of 10 parts of 10 per cent. cupric sulphate with one part of saturated sublimate unfortunately was not a success and the animal fell into fragments and is now preserved in this condition.

R. Gopala Aiyar.
University Zoology Research
Laboratory, Madras,
September 29, 1939.

[1] H. B. Bigelow, *Bull. Mus. Comp. Zoology*, 1904, **39**, No. 9.
———, *Bull. Mus. Comp. Zoology*, 1912, **54**, No. 12.

Constitution of Sulphur Nitride

Recently Arnold, Hugill and Hutson[1] have assigned structure (I) with the corresponding resonance structures (I *a*) and (I *b*) to sulphur nitride, S_4N_4. They have given many reactions in support of these structures.



I Ia Ib

We have now determined the dipole moments of sulphur nitride in benzene at 30° C. We

have found the total polarisation P_1^{∞}, 44·5 c.c., electronic polarisation P_E, 33·75 c.c., and the dipole moment μ, $0{\cdot}72 \times 10^{-18}$ e.s.u. The solutions in benzene were very dilute, the substance being difficultly soluble in benzene. The total polarisation has also been confirmed in carbon tetrachloride and has been found to be 44·13 c.c. The substance is practically insoluble in other non-polar solvents.

Structures (I) and (I *a*) should have practically no moment, while structure (I b) should have an appreciable moment due to the link $>S=S$. The observed moment being $0{\cdot}72 \times 10^{-18}$ e.s.u. and hence we assign the structure (I b) to sulphur nitride, S_4N_4.

The dipole moment of the link $>S=S$ being unknown, we are studying the dipole moments of other related compounds, with a view to arrive at a more definite conclusion.

N. L. PHALNIKAR.
B. V. BHIDE.

Chemistry Laboratory,
Sir Parashurambhau College,
Poona 2,
October 11, 1939.

[1] *J.C.S.*, 1936 1645.

On the Correlation between Life-Duration and Respiratory Phenomena

THE paper entitled "The correlation between life-duration and respiratory phenomena," published by Prof. B. N. Singh in the *Proceedings* of the *Indian Academy of Sciences* (1935, 2B, 387–402), contains several statements and conclusions which require elucidation and, therefore, the following few remarks are offered by way of a contribution towards the same.

On p. 388 (para 4) Prof. Singh states: "As growth in plants is generally localised in more or less definite regions known as meristems, the bulk of the plant body consists of what may be termed the "inert" or "non-living materials". If the words "inert" and "non-living" were omitted and the word "non-growing" substituted in the preceding sentence, the statement would be correct to an extent. This is, however, a minor point and we shall now examine the conclusions arrived at from the experimental data presented.

On p. 394 (para 3) the author concludes: "The experimental findings thus lead us to the conclusion that the relatively greater steepness of the curve of respiration is correlated with the brevity of the life-duration, while flatness in the same corresponds to increased life duration."

We have nothing to say against this conclusion, but in the Section B, after again summarising the experimental observations, the author states (p. 395): "Thus from the observations recorded, the conclusion is forced upon us that the steeper the fall in the respiratory index of the actively growing region of the meristem, the shorter the life-cycle." He then continues: "The shortening in the longevity of the plant, thus, it would seem, is a function of the rate of respiratory energy release." There is here a change of position. After concluding that these two processes are correlated the author immediately suggests that one is a function of the other, but this does not necessarily follow.

The author further cites some data on the initial rates of respiration and the average rates of respiration during the life-cycle, in support of his conclusion but they show nothing more than a correlation between these two rates.

In conclusion it may again be emphasised that we agree with Prof. Singh so far as the correlation between the two processes, *viz.*, life-duration and respiratory rate, but his thesis on "the role of respiration during the life-cycle of a single crop in determining the duration of life", remains only a speculation.

R. D. ASANA.

Punjab Agricultural College,
Lyallpur,
February 8, 1939.

REVIEWS

Protective Coatings for Metals. By Burns, R. M., and Schuh, A. E. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1939. Pp. 407. Price $6·50.

The art of coating of metals with a view to affording protection against corrosion as well as for ornamental purposes has been practised since antiquity. It is only in recent years that the mechanism of protective action has begun to be understood, as a result of which the number of available types of coatings, both organic and inorganic, has rapidly multiplied. In this book an attempt has been made to cover the whole field of protective coatings that are employed in the various branches of present-day industry. The field is so wide that each chapter of the book could well be expanded into a full-sized volume. The authors have, however, succeeded in condensing the material in such a way as to present a well-balanced account of the various aspects of the subject-matter, without sacrificing the essential details.

The book opens with a lucid and masterly summary of the mechanism of corrosion of metals, which serves as a guide to the general understanding of the subject-matter of the rest of the book. Then follow eleven chapters dealing with inorganic metallic coatings of various types, such as zinc, cadmium, tin, nickel, chromium, copper, lead, aluminum, brass, cobalt, tungsten, tantalum, noble metals, etc. Each of the types of coatings is discussed from different points of view—historical, technique of production, properties, field of application, limitations and defects, safeguards to be adopted against defects, etc. One of these chapters is devoted exclusively to the surface preparation processes applied prior to coating and another to the methods of testing serviceability of coatings.

Organic coatings of the paint and varnish type have been disposed of in three chapters, which deal with the composition of paints, varnishes, lacquers, etc., mechanism of film formation, testing and evaluation of protective films, painting practices, etc. Although this section of the book is somewhat brief, from the point of view of the importance and extent of the subject-matter, yet it cannot be denied that the material dealt with has been presented in a lucid and useful manner.

The final chapter is devoted to a brief discussion of other miscellaneous types of protective coatings not covered by the earlier chapters; these include electrolytic oxide coatings on aluminum, slushing compounds, chemical dip coatings, vitreous enamels, etc.

Throughout the book, literally hundreds of references are cited to original literature, which immensely increases the value of the book for use of students, research workers, and technologists engaged in industry. Author and Subject Indexes are also included.

The book as a whole is well-planned, well-written and faultlessly produced with very few, if any, typographical errors. No technological or scientific library can afford to do without a copy of such an excellent book.

L. C. V.

Application de la Methode du Champ Self-Consistent aux Noyaux Atomiques. By M. Matricon. (*Actualités Scientifiques et Industrielles,* Hermann et Cie, Paris, No. 654), 1938. Pp. 1–83.

In the theory of the heavier nuclei which is not susceptible to rigorous treatment, the first approximation is the statistical method; but the results obtained by this method are more of a qualitative than of a quantitative significance. The next higher approximation is the Hartree method of the self-consistent field which is the topic systematically dealt with in this book.

After a short introduction to the principles of the method, the author establishes the general systems of equations for the determination of the individual wave functions, and the exact form of the energy expression. In addition to the self-consistent field arising on account of the Coulomb interactions, there is also a systematic consideration applied to an assembly formed by two sorts of distinct particles acted upon by exchange forces. The equations and the energy expression are obtained in a convenient form so as to bring out clearly the modifications they undergo when simplifying assumptions are made regarding the individual wave functions.

The second part, which is numerical, deals with the method of integration of the equations of the self-consistent field. A number of refinements are effected in the usual methods of numerical integration. A generalisation of Fock's method, and an application of the method of W. E. Milne (*Amer. Math. Monthly*, 1926, 33, 455) to determine the eigen-values and eigen-functions of Schrodinger's equations are two of the notable features of this chapter. The methods developed are applied to the treatment of the Helium nucleus and it is shown that the value of the energy thus obtained is nearer the experimental value than the value given by the usual Ritz method.

This book is bound to be of the greatest service to workers on nuclear physics. In the bibliography at the end of the book one notes with surprise the omission of all reference to Bethe and Bacher's report in the *Reviews of Modern Physics*.

B. S. MADHAVA RAO.

L'espace Hermitien Quantique. By J. Pacotle (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 635).

This small brochure of about 60 pages is a semi-mathematical, and semi-philosophical introduction to the geometrical foundations of quantum mechanics. The three chapters in the book might be roughly described as, respectively, mathematical, physical, and philosophical in outlook.

The mathematical introduction to the notion of Hilbert space—the Hermitian quantum space as the author calls it—is based on the abstract or axiomatic method, but it may be pointed out that the treatment does not appear to be perfectly rigorous. Thus while the axioms of linearity, and of the scalar product are fully dealt with, very little is mentioned about the dimensionality axiom. As is well known, in the case of an infinite number of dimensions, it becomes necessary to characterise the space by two further axioms of separability and completeness. There is no discussion of these axioms in the book.

In the second chapter, which is physico-mathematical, there will be found a number of new and refreshing ways of looking at old things—as for example, the notions of "axes of probability," "Hermitian derivative," and "quantum derivative".

The last chapter deals with what the author calls "quantum ultra phenomena", *i.e.*, *phenomena* not of the type which can be actually verified experimentally, but those which can be subjected to *"Gedanken experimente"*. The world of ultra-phenomena is also contrasted with the noumenal world—thus the Descartes Universe of atoms would be of the latter type, while the structure of the Universe by chemical atoms is an ultra-phenomenon. The chapter contains a number of interesting and illuminating remarks, but one can hardly refrain from asking the question as to where all this speculation leads us to.

This is a thought-provoking book which one is sure to read with great interest.

B. S. MADHAVA RAO.

Réunion International de Physique-Chimie-Biologie: Congrès du Palais de la Découverte, Paris, October 1937. I. Physique Générale. (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 731), 1938. Pp. viii + 80. Price 25 *fr.*

This is a report of the papers contributed to the discussions of the International Union of Physics, Chemistry and Biology held at the Palace of Discovery in the Paris Exhibition in October 1937. We have contributions from P. Debye and F. Simon on the theory and practice of producing extremely low temperatures, Wiersma on the conductivity and supra conductivity of pure metals, Sir C. V. Raman on the Optics of Colloids and on Hypersonic Waves in Liquids, M. Polanyi on the Deformation of Solids and Balth van der Pol on Relaxation Oscillations and Demultiplication of Frequency. Short reports of the remarks made by others during the discussion are also included. The papers contributed are of the nature of rather short summaries and in the case of Sir C. V. Raman's contributions we have only the titles of the topics mentioned. We do not also find extensive bibliographies as is but natural. But it is a rare opportunity provided by the Publishers for a large circle of readers to have their ideas on modern developments in physics oriented by persuing these summaries due to master-minds and recognized workers in the several fields. Though any detailed information is not to be sought for, the present report will serve admirably as a guide to those topics which are now engaging the attention of the chief workers in science. We could only wish that each contribution was a little more extensive,

One other point which strikes us is the fact that there are numerous printer's and other errors in those contributions which are not in French, possibly on account of mistakes due to the shorthand reporter. But one does not lay any stress on such a minor imperfection when one is provided with such a sumptuous fare. We can only desire that as many as possible may become acquainted with the contents of this pamphlet.

T. S. S.

College Physics. By John A. Eldridge. (John Wiley & Sons, Inc. New York; Chapman & Hall, Ltd., London), 1937. Pp. 616. Price 18*sh.* 6*d.*

The book is written by a master in the art of teaching and as such it will be welcomed by all physics teachers whose aim in the classes is to make the subject interesting and impart to the students a substantial grasp of the physical principles involved in the various phenomena. Physics that only describes and does not explain is no physics.

The title of the book is rather misleading. It is definitely not a book written more or less in the conventional style giving a mathematical treatment of the subject, and which can be used as a text-book for the Intermediate and undergraduate courses of any University, a book in short, with which a student may learn to pass an examination in physics, without necessarily liking the subject. It is written in such a style and manner that it appeals to the student who takes an interest in the subject and to whom passing an examination is but an incident.

The approach to each subject is quite modern, the notion of electrons and protons being introduced almost at once. Modern aspects of the subject are fully dealt with in an easy and comprehensible way. The language is of the popular type without in anyway sacrificing scientific accuracy.

The tables give practical and useful information. The illustrations are numerous and self-explanatory. We warmly recommend the book to every college library.

A. S. G.

A Text-Book of Heat (Part I). By H. S. Allen and R. S. Maxwell. (Macmillan & Co., Ltd., London), 1939. Pp. viii + 527. Price 10*sh.*

The book consists of 23 chapters covering the usual topics, *i.e.,* Temperature, Expansion, Calorimetry, Change of State, Atomic and Molecular Theory, Gases, Conductivity, Radiation, the Earth's Atmosphere, Water Vapour in the Atmosphere, Thermal Units and Dimensions. The First Part "is mainly descriptive and experimental, and although the notation of the calculus is introduced, the mathematical treatment has been kept as simple as possible".

The authors have adopted the historical method, from the first speculations of the early philosophers on the nature of heat, to the more recent ideas connected with the quantum theory. The method not only possesses an educational value, but it also corresponds with the logical development of the principles involved.

Part I includes a number of biographical notes, arranged in alphabetical order. The legend that Galileo made the discovery of the isochronism of the pendulum by observing the swinging of a lamp in the Cathedral of Pisa is duly recorded as a fact.

The worked examples are well chosen. They clearly explain the principles involved. The questions and examples at the end of each chapter are taken from British Universities examinations. They are numerous and well worded, though, as usual with such questions, they smell too much of the school room. The figures are neat and clear.

A successful attempt is made at various places to bring the matter explained in the book in touch with ordinary life. See for instance the illustrations and applications of expansion (p. 86), some applications of calorimetry (p. 184), commercial applications of solids and liquids at low temperatures (p. 381), etc.

The two chapters (XXI and XXII) devoted to the discussion of the phenomena connected with the earth's atmosphere are most welcome.

On the whole, the book under review seems to be the work of able and painstaking teachers, excellently produced by the publishers, and fairly priced at 10 shillings. Not many Indian students will be able to buy it. But several copies ought to enter every College where Physics is taught.

D. FERROLI, S.J.

Systematic Qualitative Organic Analysis. By H. Middleton. First Edition. (Edward Arnold & Co., London), 1939. Pp. 273. Price 8*sh.* 6*d.* net.

The book deals with the methods that are to be employed in the identification

of the more common organic compounds. "The Systematic Schemes of Analysis" described in the book are based on the actual methods of investigation carried out by the author on more than six hundred compounds. The derivatives mentioned have all been prepared by the author and are found to be the most suitable for quick and correct identification. The author has also borne in mind the cost of chemicals to be employed in preparing the derivatives. Though the book deals with the identification of simple organic substances, the author briefly describes the methods of separation from mixtures of organic compounds. General and sometimes specific methods for the preparation of the derivatives have been given and this avoids the necessity of the student referring frequently to other books on preparation of organic compounds. The book will serve as a useful guide to students of the B.Sc. (Honours) class of Indian universities. H. S. J.

A Guide to Chemical Laboratory Practice for Beginners. By H. Bassett. (Macmillan & Co., Ltd., London), 1938. Pp. 94. Price 2/6.

This small book containing the most elementary but yet fundamental matters and operations will be very useful to a beginner entering a practical class in Chemistry. It gives very useful advice to the student in regard to the manner of handling apparatus and also regarding practical operations.

M. SESHAIYENGAR.

Intermediate Readings in Chemical and Technical German. Edited by John Theodore Fotos and R. Norris Shreve. (John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., London), 1938. Pp. 42 + 219. Price 9*sh.* 6*d.*

A knowledge of German has always been considered indispensable to the Chemist engaged in routine or research work. Hence any number of books have been written with the good intention of helping the beginner on his way. The above book is one such and is different from the generality in that, original literature has been extracted for the purpose of familiarising the student with the language.

The authors of the above book are professors of the Purdue University, the former of Modern Languages and the latter of Chemical Engineering. They have pooled their knowledge and experience in teaching in an effort to give an easy and instructive course needed by the scientist in general and the chemist in particular. Naturally their selection of material is confined to the field of chemistry. The method of instruction follows the usual form of notes on grammar and then readings in German. It would have been much better for the student if the method followed was one in which easy reading lessons are interspersed with grammatical notes on points raised in sections already read. The purpose of books, like the above, must not be to usurp the place of a regular course of instruction in grammar but to impart as good a working knowledge of it as possible.

"The selections in this series have been made to illustrate not only variety of subject-matter, but also variation in style and progressive difficulty in reading. This book is to be used in any class that has had elementary instruction in German grammar." It would have been more effective had the natural method of teaching a language been followed—especially in the case of students who have already an elementary knowledge of grammar—by explaining the difficult words and grammatical points in simple German as has been done in the excellent little book entitled *Deutschkurs für Ausländer* and published by the Deutsche Akademie, München.

The book is well printed in clear type. It can be recommended to the student of science who has to learn the language to keep himself in touch with the literature published in the German language.

N. G. C.

Travaux Pratiques de Physique, II. Optique, Électricité. By Maurice Prost. (*Actualités Scientifiques et Industrielles*, No. 731, Hermann et Cie, Paris), 1938. Pp. 110. Price 21*fr.*

This is a laboratory manual in Optics and Electricity for medical students. In Optics, spherical mirrors, spherical and cylindrical lenses, the microscope, the spectrometer, the spectroscope, the Bunsen photometer, interference (by the split lens method), the polariscope and saccharimeters (Laurent's and Soleil's) are dealt with. In Electricity we have 'J' by the electrical method, the voltameter, the Post Office Box and the Meter Bridge, the potentiometer, the ballistic galvanometer, alternating currents, and the

triode valve described. There is also a section on the absorption of β-rays. Deviations from the treatment usual in English books are found in the notation, in the lens formula $\left(\text{given as } \frac{1}{u} - \frac{1}{v} = \frac{1}{f}\right)$ and in the description of some of the instruments. It is also rather peculiar that Wheatstone's name is consistently spelt Wheastone. A very refreshing feature is the discussion of possible errors, accompanying the description of each experiment. This will give a better sense of balance to students who, as the present writer knows to his discomfiture, have a knack of displaying unwarranted decimal figures in the results of rough experiments and equally persistently omitting necessary decimals in more accurate determinations. Our B.Sc. students will have a fresh light thrown on their studies if the methods of this book are followed as an interesting variation from the usual routine.

T. S. S.

Studies in Philosophy. (*Actualités Scientifiques et Industrielles,* Hermann et Cie, Paris) (790), 1930, pp. 54; (809), 1939, pp. 149; (813), 1939, pp. 87.

The publications issued under the general heading *Actualités Scientifiques et Industrielles* afford considerable striking evidence of sustained intellectual endeavour, and in the Vol. No. 790 under notice, Emile Brehier sets forth and discusses some of the significant problems of ancient Greek Thought. After a summing up of certain considerations and conclusions general in character and indicative of the main tendencies, Pre-Socratic Thought is examined. The contribution made by Plato, Socrates and Aristotle is discussed. The volume concludes with a section on "Neo-Platonism".

(2) Vol. No. 809 contains a fairly full survey of the problems connected with Psycho-Analysis by Charles Baudouin. Psycho-Analytic Theory and Practice, the technique of Freud and others have all come to stay, and the part played by them in modern psychology is prominent sometimes even to an aggressive degree. The section on "Psychotherapy and Mental Hygiene" deserves particular mention. "In memoriam" touching the demise of Alfred Adler (1870–1937) is a fitting tribute to the memory of a powerful personality in the province of psychoanalysis. During the time of the world-War, 1914–18, war-psychoses, and war-neurosis contributed evidence of considerable importance in support of psychoanalytical theories. To-day when War again is in progress the problem of psychoanalysis gains additional significance. War-Lords, War-Mongers, by whatever name one may choose to call them, must reveal abnormal mental and physical characteristics and psychoanalysis must be indeed a vain and arid pursuit if by a successful application of its methods abnormalities of mind are not got rid of. Absence of mental hygiene is responsible for all destructive activities like Wars. The Bibliography which contains names of 44 volumes and 231 articles is needlessly exhaustive. It must be obvious not all works and articles here listed can be of the same importance or quality. One would have preferred a limited, selective Bibliography.

(3) Vol. No. 813 by le P.M.-D. Chenu, O.P., is devoted to a study of Mediæval Philosophy. The section on Arab Philosophy is a distinctive study. Trends and tendencies of the 12th, 13th, 14th and 15th centuries have been studied in a matter-of-fact manner. By no means original, the studies are useful.

R. NAGA RAJA SARMA.

Grundriss der Histophysiologie. By E. Ries. (Akademische Verlagsgesellschaft M.B.H., Leipzig), 1938. Pp. 413. Price 26 R.M.

For a long time cytological studies have been confined mainly to the nucleus. As a matter of fact, it occupied so large a part of our attention in the past that other parts of the cell, no less vital to a proper understanding of the Cellular Dynamics, were neglected or relegated to a place of secondary importance. Histology, which forms an indispensable part of zoological studies, has been taught to generations of pupils as a disciplinary course preceding Cytology, and no attempt has been made to probe deeper into the mysteries of the cell.

The antiquated methods of Cytology and of Histology have certainly outlived their usefulness, and the old-fashioned courses now only serve to train the new generation of pupils in microscopy and in microscopic anatomy. Beyond this, they have little to commend themselves. In recent years, however, more fascinating fields and pastures new have been opened out to us by Histophysiology or Histochemistry.

Not very long ago the tissue culture technique gave a new lease of life to Cytology and the recent work on Mitochondria and Golgi bodies has shown us that the nucleus is not the only box of Pandora within the cell, the cytoplasmic constituents being equally elusive and interesting. It must, however, be confessed that cytological and histological studies, even at the present time, are preponderatingly static in their method of approach and treatment. The functional phases of the cell, either in the lower organisms or in the animal tissues, have seldom been investigated with the same fervour or keenness as problems of Cytomorphology. It is no doubt true that, now and then, attempts were made to switch Cytology and Histology on to new rails but without any spectacular success.

During the last 20 years or so, Cytology has taken a new turn. Methods of vital staining and histochemistry have been tried and adopted as routine methods in some of the venturesome centres of zoological research in Europe. Judging from the results of the past few years, it is possible to hazard the opinion that these new branches of Cytology have a great future before them. In the years to come, the zoologist is bound to turn to the histo-physiological methods for the elucidation of many of the obscure points in Animal Morphology, and histochemical methods will be increasingly employed in zoological laboratories.

Not very long ago, we had an excellent manual on histochemistry by Lison and the present volume by E. Ries will be welcomed by all students of Cytology. E. Ries has provided us with a masterly survey of the whole field of Cytology and of the achievements of the past few decades. Even those who are actively engaged in this field of study will find the contents of this book informative and thought-provoking. Both the author and the publishers are to be congratulated for bringing out this useful book on this subject.

A. B. MISRA.

The Fundamental Theory of Arc Convertors. By H. Rissik. (Chapman & Hall, Ltd., London), 1939. Pp. 304; figs. 79. Price 18*sh.*

This book forms the eighth volume of *A Series of Monographs on Electrical Engineering* under the editorship of Mr. H. P. Young. The present volume on arc convertors from the pen of Mr. Rissik is very welcome, as he has contributed much to the English technical press on this all-important subject, including a volume on mercury-arc current convertors.

The mercury arc rectifier has undergone some very progressive and striking developments during the past thirty-seven years, since it was first devised by Cooper-Hewitt. The increasing use of this type of rectifier for supplying the D.C. anode power of valves in high power Broadcasting Stations, in Electric Traction, high currents in Electrolytic work, really needed a book of this kind for the specialist, where the design aspect has been kept in the foreground.

The book contains twelve chapters, divided into three parts: Part I deals with the normal rectifier circuits, Part II with that of the now increasingly popular 'Grid controlled rectifier', and Part III with the Invertor or Cycloconvertor. The text of Part I follows a small 'Introduction' of 11 pages being a survey of the practical applications, classification and historical development of convertors.

It is very welcome to find considerable data on the interrelationships of the different circuit quantities on the D.C. and A.C. sides of the apparatus. Perhaps, by far the most interesting part of the book is Part III where the latest information on 'Invertor' —(the apparatus for converting D.C. to A.C.)—is given. It is expected that this subject will have a great future in connection with the High Voltage D.C. electric power transmission over long distances—one of the dreams of the Power Transmission Engineer. The last two chapters of the book, in particular, contain valuable information on Cycloconvertor or the static frequency and phase changer, which is a highly complex outcome of the arc-convertor.

The Bibliography at the end of the book containing no less than 209 references, adds to the utility of the book.

It is somewhat disappointing to find that no good explanation or discussion of the arc-back problem is given. The general tone of the book is distinctly mathematical and theoretical, than practical. The book would have found favour with a wider range of Electrical Engineers had it been less mathematical and dealt more with practical applications and troubles, etc., in a descriptive manner.

The book should find a place on the shelf

of the reference library or the design office rather than in the laboratory, power or broadcasting station. It is recommended for the advanced student or an electrical engineer who wants a thorough understanding of the theoretical principles underlying the design and operation of the different types of arc convertors in vogue to-day. The general get-up of the book is excellent and the price reasonable.

V. V. L. R.

Organic Synthesis, Vol. XIX. By John R. Johnson. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1939. Pp. 105. Price 8*sh.* 6*d.*

With the publication of this volume which describes thirty more preparations, the recording of detailed directions for 548 organic chemical reagents is completed in this series started in 1921. The following are some of the examples which may interest a general student in this volume:—acetyl glycine, dichloracetic acid, *p*-dinitro-benzene, *iodo*-benzene, *o*-phenylene-diamine, the larger number being mostly of the more uncommon type. The details for the preparations are as usual very elaborate but considering the larger units used in these preparations, greater care will still need to be exercised by the less experienced to avoid risk of fire and explosion always associated with organic work.

B. S. R.

The Earliest Men. *Huxley Memorial Lecture,* 1939. By J. Reid Moir. (Macmillan & Co., Ltd., London). Pp. 32.

This little book is a worthy tribute to the significant work of the great scientist, brilliant in achievements and unrivalled in their exposition, whose memory is intended to be perpetuated by the inauguration of Memorial Lectures, by the Governing Body of the Imperial College of Science and Technology, 1925, following the celebration of the Centenary of Huxley's birth.

The book is devoted to expounding the evidence recently accumulated in order to furnish an answer to the question, "Where then must we look for primæval man? Was the oldest *Homo sapiens* Pliocene, or Miocene, or yet more ancient?" which Huxley had raised in his book, *Man's Place in Nature.* Palæontologists and archæologists are now agreed in thinking that man existed in the Pliocene period and they are satisfied that the material at their disposal warrants such a conclusion. Whether his antiquity extends into the Miocene is a proposition on which only tentative conclusions can be reached, in view of the differences of opinion on the Eoliths in the Aurillic series discovered in the gravel deposits of Upper Miocene Age in the Cautal, France. In the case of stone implements which form in the majority of cases the sole survivals of man's past history, there is bound to be room for the opinion that they may have been of natural origin or that they were shaped and used by intelligent beings. To the third question of Huxley, whether man existed in still older periods, no answer can be attempted at present.

The author also discusses in his address the origin and antiquity of the modern type of man, with reference to the discovery of portions of a human skull of this type in the 100-foot terrace of the Thames. "To greatly extend our conceptions of man's antiquity appears a necessity" and taking into account all the available evidence, it will extend, perhaps, as far back as two million years.

The subject of man's origin and his antiquity must always exercise a strange fascination on the imagination of modern man and this story is presented in the book with all the charms of literary grace and scientific judiciousness.

Colon Classification. By S. R. Ranganathan. Revised Edition. (The Madras Library Association, Madras; and Edward Goldston, Ltd., London), 1939.

Rao Saheb S. R. Ranganathan has done a great service by publishing a revised edition of his *Colon Classification,* an original work, which, while assimilating all that is best in the standard schemes in use in Western countries, improves upon them by constructing a schedule of classification suited to India with the advice of authorities on the several subjects like Science, Linguistics, Religion and Philosophy. This is amply illustrated by the attention paid in the scheme to Hindu Religion, Indian Philosophy, Spiritual Experience and Mysticism, Sanskrit and South Indian Languages like Tamil.

The first three parts and numerous examples given in Part IV help the clear grasp

of the principles of Colon Classification and its application to advantage to the vast stores of books on Indian civilization, philosophy and culture, especially of the South.

K. KASTHURI RANGACHAR.

Plant Breeding Technique in Recent Years. By R. H. Richharia. (The Bangalore Press, Bangalore City), 1939. Pp. 73. Price Rs. 2-8.

The publication of this book has removed the long-felt want of amateur plant breeders and persons interested in the science of plant breeding, who have neither the necessary background for understanding the subject nor the proper opportunities to learn the modern technique. It will also be of great use to students of Agriculture and Botany.

The author has divided the book into fourteen chapters describing the different aspects of plant breeding and vividly putting forth the importance of cytological investigations in understanding the problems of plant breeding and genetics, especially by the non-Mendelian methods. Chapters on polyploidy, haploidy, decapitation and effect of temperatures, chemicals and radiations are particularly intersting.

Numerous diagrams and illustrations make the reading of the book more interesting. The get-up of the book and printing are excellent.

R. J. K.

From J. J. to G. P.

Theory and Practice of Electron Diffraction. By G. P. Thomson and W. Cochrane. (Macmillan & Co., Ltd., London), 1939. Pp. xii + 334. Price 18*sh*.

SIR J. J. THOMSON, while describing the discovery of the electron writes in his book *Recollections and Reflections*: "At first there were very few who believed in the existence of these bodies smaller than atoms. I was even told long afterwards by a distinguished physicist who had been present at my lecture at the Royal Institution that he thought I had been 'pulling their legs'." Professor G. P. Thomson when he first published in 1927, photographs obtained by sending a beam of homogeneous cathode rays through a very thin film of collodion, could also have been accused of leg pulling. The average physicist then was either unaware of de Broglie's theory or he did not suspect that there would be such a strong coupling between the probability waves and atoms, which would permit them to form diffraction patterns of appreciable intensity. The fundamentals on which this significant achievement has been based are now recounted in this book.

The first chapter deals with the fundamental properties of wave motion and de Broglie's wavemechanics. The theory has been written from the point of view of an experimental physicist, and the physical significance of various mathematical operations has been cleverly pointed out. Thus about the Huygens' construction the authors write that it implies nothing not already given by geometrical optics. They define group velocity as the velocity with which a peculiarity associated with the group, such as a maximum of amplitude will advance.

De Broglie started from the idea that Einstein's equation $E = h\nu$ represents a fundamental relation between energy and frequency. By the theory of relativity a particle of resting mass m_0 has associated with it energy $m_0 c^2$, and should therefore have an inherent frequency $\nu_0 = m_0 c^2/h$. De Broglie regarded this as the frequency of a pulsation in the space surrounding the particle. The wave velocity is $V = c^2/u$ and the corresponding wave-length is $\lambda = h/mu$. De Broglie's idea that the waves act as a guide for the particles and determine their motion necessitates that the ordinary Newtonian mechanics, or rather their relativistic generalisation should be replaced by laws which involve the conception of waves. When experiments are carried out to verify de Broglie's law, it would appear that the theory holds up to as high as a million volts, to better than 5 per cent. This result is important because the theory given by de Broglie is incomplete as it takes no account of the spin of the electron; but the terms involving spin should be expected to become important for speeds near the velocity of light. Thus the equation

$$\nabla^2\psi + \frac{8\pi^2 m_0}{h^2}(E - F)\,\psi = 0$$

is incomplete and it is therefore interesting that it still gives the right value for the wave-length.

The readers are next treated to an account of Ewald's reciprocal lattice, and

how the pattern obtained on a distant screen will be the projection of the points of the reciprocal lattice lying on Ewald's sphere. It is only in exceptional cases that a point will lie actually on the sphere, but the rigorous conditions are relaxed in various ways. The wave-length of the electrons will not be exactly fixed, the real crystals have imperfections, and these imperfections assume enormous importance as the angles of diffraction are very small. This enables the authors to explain such phenomena as the Kikuchi patterns, the so-called forbidden spectra and the subsidiary diffraction maxima observed by Finch and Wilman.

The intensity of the diffracted beams depends not on the atom form factor only but also on the structure factor. The most important point that appears is the very large values of the scattering of electronic waves as compared with X-rays.

There are three chapters which will be of great use to experimental physicists interested in electron diffraction. The effect of the refractive index of the specimen is described and it is pointed out that such an effect should be considered only in the case of reflection experiments from reasonably smooth surfaces. The formation of Kikuchi lines, their changes of intensity and the envelopes of Kikuchi lines have received their due share. The effect of temperature and the size of the crystals on the dimensions of the lattice has been pointed out. But the description of the principal types of diffraction patterns observed and the way they should be interpreted is so important that a beginner would be well advised to master it before he starts taking electron diffraction pictures. It is interesting to note that the minimum thickness to give a detectable pattern with 30,000 volts electrons is of the order of 10–12Å; and it is this property which makes the electrons indispensable for surface investigations. The authors point out that part of the electron diffraction technique is ordinary vacuum practice. They also describe the various types of electron diffraction cameras which have been evolved, how the specimens should be prepared, and photographic patterns measured.

In a limited number of special problems, a large proportion of the information has been obtained by the application of electron diffraction methods. The problems thus treated are the measurement of inner potential, the study of the growth of crystals, the nature of oxides and the polished layer and the structure of oils, greases and lubricants. There is also a wider field in which the method of electron diffraction can be used. The authors after describing the technique and the theory of electron diffraction by gas molecules point out that the interpretation of electron diffraction patterns from gas molecules is not so straightforward as in the case of crystalline solids. Generally speaking, a trial and error method must be adopted; a molecular model of definite dimensions has to be found such that the calculated distribution of intensity agrees with the experimental results. This is illustrated by applying the method to a benzene molecule, and pointing out that in such a case it is possible to infer that the C – C bond 'resonates' about equally between a single bond and a double bond. Lastly the slow electrons have an advantage over fast electrons in that they are more sensitive to absorbed gas.

The book closes with a discussion of the present limitations of the theory. Thus a full description is given of Bethe's dynamical treatment of the diffraction of electrons. And although the dynamical theory is based on sounder foundations than the kinematical, it has not been able to claim more successes than its rival—the kinematical theory—which has the advantage of simplicity. Darwin's version of the theory of the spinning electron is given and it has been pointed out that the detection of any effect due to magnetic moment or polarisation is not an easy matter. All theoretical physicists except Mott find no appreciable effects due to polarisation, while Mott finds that nuclear scattering ought to produce an appreciable asymmetry of the scattered electron beam if certain conditions are fulfilled. The experimental results, however, definitely prove that Mott's theory is not correct, as applied to the scattering of electrons by thin films of gold.

The treatment of the subject is throughout lucid and *anschaulich*. The book combines the unique qualities of simplicity and authority and as such is likely to prove itself the bible of electron-diffractionists or should we say interfractionists. But could we expect anything else from a book that comes straight from the pen of Prof. G. P. who is the world-authority on the subject of electron diffraction?

K. R. Dixit.

Spectroscopy and Its Applications

Proceedings of the Sixth Summer Conference on Spectroscopy and Its Applications, 1938. Edited by G. R. Harrison. (Massachusetts Institute of Technology Press; Chapman & Hall, Ltd., London), 1939. Pp. vii + 172 (10″ × 7·5″). Price 15*sh.*

APPLIED Spectroscopy is in a period of active growth. Astronomers, biologists, chemists, geologists, metallurgists, physicians, physicists, and industrialists of many kinds find the techniques of spectroscopy of great advantage, and are taking to it at an increasingly rapid rate. Thus H. R. Kreider of the American Medical Association Laboratory (p. 53) says: "We have practically omitted the chemical qualitative analysis except as a test: .... exact qualitative analysis of from 10 to 15 materials may be made in an hour, and a permanent record of the analysis obtained. This permanency of records is extremely important in the event of law suits, which play a rather important role in the work". Further, notwithstanding certain limitations, spectral analysis has already displaced gravimetric analysis in many instances of routine or control work, opened new fields in science and industry, and gives promise of going still further. It is interesting to recall in this connection that much of this confidence and spread in practical applications is largely due to our theoretical understanding of the principles of spectral emission, based on the work of Bohr and a host of other physicists. One has got only to add to these techniques those of the molecular spectra of the Raman type, which are now equally accessible in an analytical laboratory, to realise the future possibilities.

Under the ægis of the Massachusetts Institute of Technology, annual Summer Conferences have been held on spectroscopy and its applications, commencing from 1932. The volume under review contains, though in an abbreviated form, the 31 papers presented during the Sixth Conference held in July 1938. The subjects covered comprise a very wide range, from descriptions of specific applications as in the investigations of vitamins, enzymes, rare earths in plants, minerals, criminal investigations, etc, to discussions of the methods of exciting spectra, *e.g.*, 'characteristics of spectroscopic light sources' (p. 54), their recording, *e.g.*, use of grating spectroscopes (pp. 71, 80) and their evaluation, *e.g.*, 'a high speed method of absorption spectrophotometry' (p. 91). This last paper describes an apparatus, developed at the M.I.T., which permits density measurements to be made at the rate of 10 or more per second, using a combination of concave grating monochromator, amplification of photo-electric currents with an electron multiplier, and recording with a cathode-ray oscillograph and motion-picture film. There is also the desirable leaven of papers of theoretical interest, *e.g.*, 'photo-chemistry of visual spectrum' (p. 134), and 'the photographic latent image from the standpoint of the modern theory of solids' (p. 157).

Though the papers are presented in an abbreviated form, they are clearly illustrated and include references to original papers. The get-up of the volume leaves nothing to be desired.

M. A. G. RAU.

Evolution of the Human Brain

THE size of the Primate brain ranges from about 3 gms. in Tarsius to as much as 2,000 gms. in Man. Its basal structural pattern, however, remains the same throughout the Order and in Old World Primates the interrelation of surface to weight of the cerebral hemisphere and of its parts is more or less constant. The difference in brain-size between an Old World monkey (*e.g.*, a rhesus monkey) and a gorilla is far greater relatively than the difference in size between the gorilla and Man. Yet few, if any, significant and measurable difference exist between the intelligence of the monkey and gorilla, whereas an enormous gap exists between the intelligence of Man and that of any other Primate. The anatomical evolution of the brain thus hardly parallels the evolution of intelligent behaviour. Experimental study has also indicated that there is relatively little difference in the level of learning ability between an ape and an animal as far removed as a goldfish. Significant advances in the evolution of human intelligence would seem therefore to be related to the development of speech and to the elaboration of a symbolic process.—(S. ZUCKERMAN—British Association for the Advancement of Science, Dundee, 1939—*Journal*, p. 118.)

CENTENARIES

Bree, Robert (1759–1839)

ROBERT BREE, a British physician, was born at Solihull, Warwickshire, in 1759. Having received his education at various places he took his M.D. in 1791. After having served for a short period, he had to return from the profession temporarily in 1793 as a result of an obstinate attack of asthma.

Authority on Asthma

He resumed work next year at Birmingham. In 1797 he published his *Practical enquiry into disordered respiration, distinguishing the species of convulsive asthma, their causes and indications of cure.* This work is said to have embodied experiments in his own case. It soon became a popular book and reached its fifth edition in 1815, in addition to its having been translated into several languages. It is claimed that this book gave a complete account of the disease and laid down some therapeutic rules of universally acknowledged practical value. Bree's specialist knowledge of asthma brought him to the notice of the Duke of Sussex, who induced him to migrate to London.

His other Publications

Bree also published a small tract entitled *Cholera asphyxia* (1832) and a few papers, *e.g., On the use of digitalis in consumption* (1799) and *On painful affections of the side from tumid spleen* (1811). He delivered the Harveian lecture of 1827 and published it later.

His End

It is an irony that this specialist in asthma fell a victim to the disease once again in 1833 and was thus disabled from further work. Eventually he died of the same disease on 6 October 1839.

Thurston, Robert Henry (1839–1903)

ROBERT HENRY THURSTON, an American engineer and educationist, was born in a family of engineers in Providence R.I. 25 October 1839. Having worked in his father's shops for some time, he entered the Broun University and graduated in 1859.

Pioneer in Engineering Education

On the outbreak of the Civil War, Thurston volunteered as a military engineer. Having seen active service from 1861 to 1865, he became assistant professor in the Naval Academy. In the meantime his contributions to the *Journal of the Franklin Institute* had earned such a name for him that he was invited to organise the newly founded Stevens Institute of Technology. His work at this Institute was largely pioneer in character as there were few precedents and guides. He built up this Institute in a bold and striking way from 1871 to 1885. He made laboratory training compulsory and he established the first mechanical laboratory in 1875.

Bobbyology

After a short breakdown in health due to his zeal for work outrunning his physical endurance, Thurston became the Director of the Sibbly College of Mechanical Engineering in the Cornell University. This post he held till his death. During this period the strength of the College rose from 63 to 885. He had the ability to present scientific results with great clearness. He was affectionately known among the undergraduates as "Bobby" and his lectures on steam-engine as "Bobbyology".

His Contributions

He served on many engineering and industrial commissions. He was one of the founders of the American Society of Mechanical Engineers (1880) besides being a member of several other learned bodies. He was a voluminous writer. He published 20 volumes and 300 papers besides contributing to the *Century dictionary* and editing the engineering articles of the *Universal cyclopædia.* His first book *A history of the growth of the steam-engine* came out in 1878 and every succeeding year saw at least one new book of his till his publication of *The animal as a machine and a prime motor, and the laws of energetics in* 1894.

His Influence

In spite of the prolific nature of his writings, it is said that his influence was even greater through his teaching. It is claimed that "Hundreds of engineers who passed under his personal instruction, being touched by his loyalty to scientific truth and his high ideals of life and service and carrying into after-life the inspiration of his example, were the most influential contribution to his profession of this pioneer in the domain of engineering education".

Thurston died suddenly on 25 October 1903.

S. R. Ranganathan.

ASTRONOMICAL NOTES

Planets during November 1939.—Mercury will be an evening star in the early part of the month and on November 8 attains greatest elongation (23° 10′); on November 18 it is stationary and passes inferior conjunction with the Sun on November 28. Venus also will be an evening star; and on November 18 is in conjunction with Mercury, the angular distance between the two planets at the time being only about a degree and a half. Mars continues to be visible near the meridian at about sunset; on November 29 it will be in quadrature with the Sun. The planet is gradually becoming fainter the stellar magnitude being +0·2 at the end of the month. Both Jupiter and Saturn will be on the meridian in the early hours of the night and are favourably situated for observation. The former will be at one of the stationary points of its geocentric orbit on November 25. Uranus which is about 3° south of the fifth magnitude star ζ Arietis will be in opposition to the Sun on November 13. There will be a close conjunction of the planet with the Moon on November 25.

Comets.—Information has been received of the re-discovery of Periodic Comet Tuttle on August 12 by Jeffers and Moore (*U.A.I. Circ.*, 790). The comet was detected very close to its computed position. It is moving in a south-easterly direction and, early in November will be situated in the constellations Sextans and Hydra. It is rapidly approaching the earth and is likely to become bright enough to be seen with some simple optical aid. The Comet is the most interesting member of the Saturn family; and its period is 13·6 years.

Two of the principal meteoric showers will occur in November—the Leonids, November 13–15 and the Andromedes, November 17–27.

Variable Star.—The well-known eclipsing binary Algol (β Persei) is well placed for observation practically throughout the night during the month. The period of light variation is 2·867 days and the range between magnitudes 2·3 and 3·5; the change in light is most easily noticeable about an hour and a half before and after the times of primary minima, one of which will occur at 8 p.m. on November 2. T. P. B.

Magnetic Notes for August and September, 1939

DAILY CHARACTERS.*—The magnetic activity during the months of August and September 1939 was less than that during July 1939. There were 2 days of *moderate* disturbance in each of the two months. August had 2 days of *great* disturbance while September had none. The number of *slightly* disturbed days during the two months were 16 and 17 respectively. *Quiet* days numbered 11 during each of the months of August and September.

During these months the days on which the magnetic conditions were quietest were August 2nd and September 24th. The most disturbed day during August was the 22nd and that in September was the 17th. Of these two days, the intensity of disturbance on August 22nd was much larger than that on September 17th. The table gives the distribution of all days in the two months classified according to the magnetic character of the days.

Dates 1939	Quiet days	Disturbed days		
		Slight	Moderate	Great
August	1, 2, 4–7, 15, 27, 29–31	3, 8–11, 13, 14, 17–21, 24–26, 28	16, 23	12, 22
September	1, 5, 7, 8, 16, 22–24, 27–29	2–4, 6, 10–15, 18–21, 25, 25, 26, 30	9, 17	Nil

Magnetic Storms.—During August 1939, there were three storms (two of great intensity and one moderate). The beginnings of the great disturbances were marked by conspicuous sudden commencements' in the H, D and Z magnetograms of the Alibag Magnetic Observatory. In September, two storms of moderate intensity with gradual beginnings were recorded by the magnetographs. The number of storms recorded during the corresponding months of the year 1938, were three (all moderate) and four (one great and three moderate) respectively.

Other Magnetic Phenomena.—On September 29th, the H, D and Z magnetograms showed a perturbation between $08^h\ 00^m$ and $08^h\ 13^m$ G.M.T. The All-India Radio authorities in Bombay observed an unusual fading of short-wave reception signals from 1–30 p.m. Indian Standard Time, on this day, the fading continuing for a long time. The GMT of beginning of the perturbation referred to corresponds to the time of beginning of the radio fade out.

Monthly Characters.—The characters based on the International scheme of classification give the mean monthly values for August and September as 0·77 and 0·70. The figures for the corresponding months during 1938 are 0·81 and 1·03.

Tambyacha Bungla, Colaba, Bombay 5. M. R. RANGASWAMI. D. L. CHAUDHURI.

* The daily magnetic characters are determined in accordance with the procedure explained in para 1, of "Magnetic Notes for July 1939", in *Curr. Sci.*, **8**, No. 9, p. 434.

The Scope and Limitations of Physical Anthropology*

PHYSICAL Anthropology is the study of Man as an animal. As the physical nature of Man underlies all his cultural activities, Physical Anthropology is the most fundamental among the subdivisions of anthropological science. As contributions to the knowledge of Man are made by numerous departments of science, periodical evaluation and review of specialist data are of importance to keep up the coherence of Physical Anthropology and also to maintain intelligent contact between representatives of the different branches of Anthropology.

Zoological Position of Man

Recent studies in comparative anatomy, embryology and physiology substantiate in general the orthodox view of anthropologists that a common ancestral stock has given rise to Man and the anthropoid apes, but this view requires to be modified in several points of detail on account of the factor of convergence that complicates human phylogenetic problems. "Resemblance is no proof of relationship", but may be due to parallelism in evolution. For example, the simian features of the extinct lemurs of Madagascar have to be attributed to parallelism, and contrary to the common accepted classification, Lemuroidea cannot be regarded as having given rise to the higher primates, as, in early geological times, they showed specialisations which were avoided by the latter. If the palæontological evidence that irreversibility is a general feature of evolutionary development be accepted, it may be inferred that the ancestral stock from which Man came did not have limbs that were specialised for arboreal life. This will lead us to the conclusion that the man-like characters of the gorilla are parallel developments. It however remains true that Man has a simian ancestry, and G. G. Simpson's superfamily, *Hominoidea*, which includes both Man and anthropoid apes is justified. Comparative physiology of *Hominoidea* is also complicated by the effects of parallel developments. Similar blood groups have, according to Zuckerman, arisen independently in Man and anthropoid apes.

Palæontological Evidence of Human Origin

The solution of most of our problems of human phylogeny will, in future, depend on fossil records as they turn up. Such fossil evidence as are now available are meagre, and have been made much of. Some of the primitive Miocene anthropoids of the old world, particularly *Dryopithecus*, show striking resemblance in their dentition to Man. The splitting up of the *Hominoidea* into several genera appears to have happened early in Miocene times. No Pliocene Man is known to us in spite of the evidence offered by stone tools referred to that age. The earliest *Hominidæ* discovered are *Pithecanthropus* and *Sinanthropus*. Taking in to consideration the relatively greater variability of Man, it appears that anthropologists have exaggerated the points of difference between *Pithecanthropus* and *Sinanthropus* and made two genera of them instead of one. While the skull, brain and teeth in *Pithecanthropus* retained primitive simian characters, the limb bones were like those of *Homo*. This is of significance in showing that the differences in limb structure between Man and anthropoid apes are very old, and that the divergence between the two groups must have taken place at a relatively remote period.

Neanderthal Man of later Mousterian date was more specialised than modern Man, who, it seems certain, was derived, not from these extreme Neanderthals, but from more generalised types of earlier date.

The study of endocranial casts is useful but has its own pitfalls. The convolution patterns in Man and anthropoid apes are not correctly impressed on the bones as in the lower animals. Too much emphasis has been laid in the past on the "simian sulcus" in the study of endocranial casts of fossil *Hominids*, but Elliot Smith has shown how misleading this "simian sulcus" can be. According to him, some modern human brains occasionally develop a sulcus which is easily mistaken for the simian sulcus.

In the study of individual skeletons there are considerable difficulties due to our inability to eliminate variations due to differences in habits, diet, etc. Even the determination of sex offers difficulties when only skulls are available for study.

Physical Anthropology of Race

There is considerable overlap in racial characters even among primary races owing to the "reticulate evolution" of Man. Many of the racial characters now adopted are themselves susceptible to environmental influences, which may obscure fundamental similarities. Blood groups are more reliable, but there seems to be no correlation between them and body types. The determination of racial characters of prehistoric peoples from a study of their skeletons is again of uncertain value. The Grimaldi skulls of Europe, for example, were regarded as Negroid, but Elliot Smith was of opinion that they were merely variants of the Mediterranean race. R. A. Fisher has also shown the greater advantages of the study of the living over that of skeletal material.

The Future of Physical Anthropology

With the handicaps inherent in the material, and with the existing technique, it is doubtful if sensational progress will be made in Physical Anthropology. But biometry still holds the key to the understanding of the composition of geographical groups of Man. Physical Anthropology will have to become more of a field science and study Man as he is to-day, attacking such problems as the relation of nutrition to physique, effects on physical types of change of environment, the phenomenon of twinning, the relation of bodily types to mental traits, etc. Human genetics will have to be studied by the anthropological method. Various formulæ have been devised for assessing the nutritional status, but anthropologists will have to determine what the normal physical type is for a given population.

A. Aiyappan.

* Summary of Address by Prof. W. E. Le Gros Clark, F.R.S., President, Section H—Anthropology, British Association for the Advancement of Science, Dundee, 1939.

Practice with Science*

"PRACTICE with Science", the familiar motto, forms the title of the Presidential Address to the Agriculture Section delivered by Sir Thomas Middleton who curiously enough as he himself recalls presided at the very first meeting of this Section held in Dundee, the centre of the present meeting, when the Section was constituted in the year 1912, now fully twenty-seven years ago. Agriculture has during this period passed through strange and diverse vicissitudes, the epoch of the Great War, post-War upheavals, disastrous price slumps and all but stark ruin, despite, as the address points out in contrast, the great advances on the scientific side of agriculture. The address deals with some of the aspects of the farmer's position during these years, most of which are as familiar as they are baffling. One result as far as Great Britain is concerned is the fact that whereas during the decade 1831–40 the land of that country maintained a population of about 17 millions it now provides food for only about 14 millions. Examples are given from farm surveys to show that the above result is due to the unprofitableness of farming in the country. In the forty-eight years preceding 1919 in one of the farms in the survey a loss was incurred only in two years and in neither year was it a large one; in the fifteen years following 1919 there were six years of loss and the returns per acre in the period prior to 1919 were 75 per cent. greater than they were in the fifteen years following. The plight of the American farmer has been much more serious and this notwithstanding the stupendous efforts of that Government to assist farmers in many directions with the help of a 500,000,000 dollar fund placed at the disposal of the Federal Farm Board. In spite too of drastic measures to dispose of surpluses such as the burning of coffee in Brazil and of wheat in the U.S.A., the slaughtering of pigs and cows by thousands in Denmark and Holland, no relief has been in sight. Though much of this distress is due to the disturbance of normal conditions caused by the Great War, the Address calls attention to circumstances peculiar to agriculture which keep agricultural earnings low; one such is referred to as the tendency to treat food as a commodity on a different footing from other commodities on the idea that it belonged to the nation, *i.e.*, the non-agricultural consumer rather than to the land worker who produced it; the farmer's inability to restrict and adjust output to an anticipated fall in the demand is another serious handicap. American figures, indeed, show that while in a group of years of high prices 22·9 million acres were sown, in a low price period the area rose to 26·5 million acres, the price index during the two periods being 96 and 43 respectively. Conditions in the distributive trades are also such that no matter how high prices may rise for the consumer the farmer gets very little of the advantage. Here is an interesting instance: when the 4-lb. loaf cost 5¼*d.* as it did in 1906 the farmer got 53% of the consumer's money, whereas with the 4-lb. loaf costing 8½*d.* as it does now, the farmer gets only 30% of the proceeds and even that only with the assistance of the Government subsidies. British fiscal policy cannot be held responsible for the depression in British agriculture as is often argued because other countries where a different policy prevails are faced with the same situation. Much is due to factors inherent in agriculture and the world has over a long period been fed at less than cost price, assuring that in cost we include a standard and equated remuneration for service. The subsidies and other Exchequer grants now being made to agriculture are to be regarded in this view not as doles but as deferred payments by the nation, which by implication leads to the conclusion that as long as farming continues to be an unprofitable undertaking the producers of food should be helped out by such grants.

The Address next takes up the second part of its theme, *i.e.*, the scientific worker's programme. During the past thirty years scientific research in agriculture has made great progress and the prospects are now better than ever. Sir Thomas recalls that in his first report from Whitehall he had to point out that the State grant for agricultural research was only £380; at the present time the grant from the Development Fund alone amounts to £500,000. Sir Thomas would disclaim any idea of blaming scientific workers for the enormous surpluses of food, though large increases are undoubtedly due to the activities of plant breeders, chemists, pathologists and others. In considering how best the scientific worker can help in the present situation the example of American reaction to the situation as described in the Yearbooks of Agriculture for the last three years is held up for guidance in respect of the development of national resources and the creation of superior life forms, picturesquely called the "Superior Germ Plasm". The experiment stations are to seek means whereby with the same expenditure of time and energy more food may be produced. Reference is made to the hunt for new plants either desirable in themselves or as breeding material for new types, of the 6,000 such new plants got together by Australia, of the expedition to South America to secure new forms of Solanum for potato breeding, and of the new clovers and grasses now being evolved. In Great Britain soil conservation has been carefully attended to but the need for a more intensive study of soils *in situ* and in greater depths in accordance with recent methods is emphasised. Balanced nutrition, both of humans and of domestic animals, is to be looked at as closely interdependent so that an improvement of the forage, and health and quality of the latter may lead to a lowering of the cost of animal food to the farmer and to their

* Summary of Address by Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., D.Sc., LL.D., F.R.S., President of Section M—Agriculture—British Association for the Advancement of Science, Dundee, 1939.

consequent improvement in health. The opening of a special station for the study of several obscure stock diseases, committees for the investigation of virus diseases, the preservation of grass and other fodder crops, the addition to the entomological and mycological staffs, and the assistance to fruit research may be mentioned among further efforts on the scientific side.

Finally, the address deals with the role which British agriculture should play in the event of war, and here Sir Thomas would strongly advocate an agricultural policy that would enable the country to produce more food than it now can. The storage of food materials and the ensuring of imports by keeping the seas open, will by themselves not be sufficient and in spite of superior antisubmarine methods in a protracted war the call on the land would be at least as great as it was in the Great War. Much controversy notwithstanding, grass land will have to be broken up and an even more intensive "speed the plough" campaign will have to be carried out, because compared with 1917 and 1918 the arable area has gone down by 3,900,000 acres which is now all under grass. A change in the method of farming is also necessary, *viz.*, a system which under peace conditions would provide about from 35 to 40 per cent. of the requirements and in an emergency would enable us to rapidly increase it to about 50 per cent., that is to say, a system of temporary grass to replace part of the present permanent grass, as is already in vogue in Scotland. The flexibility of the system which makes it suitable both for peace time as well as for war time, is a great advantage in its favour. Many problems would arise in connection with such a change-over from an old established practice of the country and in addition to enlisting the confidence of the farmer much intensive research at a special central research station will be necessary, which will include economic studies and a dissemination of the results of such studies among the younger folk. Sir Thomas is convinced that the change-over will result not only in a larger output of production, but also improve the prospects of farming. The nation, however, will have to pay and as it is for services rendered in connection with defence the farmer's claim will be quite as legitimate as those of others similarly engaged. The address, it must be stated, was written before the war clouds burst over Europe and now that the dreaded situation has actually arisen, the address gains added significance.

A. K. Y.

Instruments in Science and Industry*

IN the past, although none too frequently, has the invaluable help rendered by the instrument maker attached either to the laboratory or to a commercial firm, been gratefully acknowledged in many scientific publications. The probable soundness of a theory largely depends upon the accuracy of the data discussed, and among the mathematician's first needs are reliable physical facts. The requirements of the present day are rather exacting and to meet them, all observers now demand far more from their apparatus than was formerly possible, but few realise the amount of thought and labour involved in raising the accuracy obtainable from one per cent. to one tenth of one per cent.

"The development of a particular subject has grown largely with the perfection of the instruments used to investigate it. It is in every way a reciprocal process. By means of an instrument certain evidence is obtained; this evidence does not go far enough, and the instrument must be improved to enable further facts to be found. If, for example, the biologist requires to examine small bodies beyond the range of his microscope, he appeals to the physicist to help him, and the appeal is not in vain. Most probably, as the result of the work on his colleague's problem, the physicist developes a technique which will be of service either to him or to a fellow-physicist."

Mr. Whippley has chosen for his presidential address, the fascinating, but rather wide theme of the help that instruments have given during the centuries to the development of science. The histories of the microscope, telescope, and spectroscope are recounted in a brief but very interesting manner. Mr. Whippley then deals with the modern auxiliary devices such as the fine dividing engines, temperature measuring instruments, galvanometer and thermionic valve appliances.

"In preparing the design of an instrument it must never be forgotten that a good design helps production. It always pays to spend time in the drawing office rather than in the workshop. The application of geometric design often reduces the cost of manufacture, and makes a better instrument. The experimentalist, in making up his own instrument, should consider whether he can obtain the same result by a simply designed geometric piece of apparatus, rather than the more elaborate design to which he may be attracted.

"The instrument maker constantly receives incentives to progress from the scientific worker to whom he owes not only suggestions, but many of his new materials. If knowledge is to progress, it is essential that theory and practice advance together. Nowhere is this more true than in the development of scientific instruments."

M. A. G. Rau.

* Summary of the Presidental Address by Dr. Robert I. Whippley, British Association for the Advancement of Science, Dundee, 1939.

SCIENCE NOTES AND NEWS

The Garner Principle of Co-operative Activation.—Certain reactions such as the denaturation of proteins and the dehydration of calcium carbonate hexahydrate take place at abnormally high rates. To explain this phenomenon, Garner (*Nature*, 1939, 144, 287) proposes a mechanism based on co-operative activation of a number of points n on the surface, the activation energy required at each point being E/n, where E is the measured activation energy. F. G. Donnan (*Nature*, 1939, 144, 446) has pointed out the great importance of the principle in the formation of many catalytic phenomena and in the interpretation of the interlinked sets of reactions which are known to occur in the operation of many enzymes and co-enzymes. K. S. G. D.

* * *

The Coconut Palm Beetle.—This familiar coconut pest commonly known as the rhinoceros beetle is one of the most discouraging and distracting features in the cultivation of the coconut tree in many parts of South India where it is more responsible than any other single factor for causing a serious set-back to the young growing tree, leading in the case of neglect to a complete destruction of the tree. It is probably one of the pests regarding which requests for suitable remedies are received most frequently. A considerable amount of study both in respect of its life-history and of remedial methods has been made but it is nevertheless a fact that many lacunæ exist in the former while as regards remedies no satisfactory ones are yet known. On both of these aspects and especially in connection with the life-history of the pest a careful study extending over a long period has been made, the results of which are now published (M. C. Cherian and K. P. Anantanarayanan, *Ind. Jour. Agr. Sci.*, 9, Pt. III). The duration of the egg period, the larval and pupal periods are all subject to considerable variation and are found to be 9 to 17 days, 100 to 180 days, and 24 to 62 days respectively, the period from egg to adult varying from 129 days to 232 days. The adults themselves were found to live for periods up to a maximum of 293 days. It is also brought out that the beetles are active throughout the year although during certain months of the year, *viz.*, March and April, the pest is most active; elsewhere too this is the same experience, the peak of the damage being soon after the first rains begin. Work on remedial methods which of course are more important from a practical view-point has not led to any helpful recommendations; a trial has been made of various baits, none of which was found of any use. We have noted however that a mash made up of a little groundnut oil cake with cow-dung proved remarkably effective as a bait. We find no reference to the spraying with Bordeaux Mixture which was tried as a good repellent in certain Mysore trials. Various other devices which are probably mere "nostrums" but which may have something in them also deserve to be tested out especially in a thorough going investigation of this kind. The growing alongside coconut plants of plantains and of *Euphorbia tirucalli*, the use of common salt, nux vomica leaves and fruit, the oil cakes of some species of Hydnocarpus are mentioned as repellents of this category—inquiries may bring out more—and these deserve a trial. The familiar skewering out with an iron rod with a barbed end apparently holds the field, in the trials reported. A. K. Y.

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Alcohol as Motor Fuel.—Now that a beginning is being made in India in the use of alcohol for mixing with petrol as fuel in motor vehicles, trials conducted elsewhere on the suitability of such mixtures should be both valuable and interesting. The report of an elaborate trial with alcohol used nearly straight and in mixtures of varying proportions with petrol for driving a motor car appears in the *Philippine Agriculturist*, 28, No. 2 (A. L. Teodoro, Fifty thousand kilometres on alcohol as motor fuel). The trials relate to two groups, one comprising the use of nearly straight alcohol (gasoline being only 3% and 5%) and the other comprising mixtures in which the gasoline was 10, 30, 50, 70, 80 and 90 per cent. The car used in the trials was a De Soto De Luxe Sedan (1929 model) which had run on gasoline for four years during which a distance of 10,678 miles had been driven. Slight alterations were made to the car before the trials such as, enlarging the diameter of the high speed metering jet, and of the area of the pump discharge jet; ignition timing was set 5 to 14 degrees ahead of the usual adjustment for gasoline, and idling adjustment was changed according to the kind of alcohol motor fuel used. Details of the behaviour of the engine in respect of starting, acceleration, power, engine wear, corrosion and economy of operation are given in full. Likewise for each one of the fuels used particulars under working conditions and of the number of miles driven are also given, with full numerical data, for all of which reference to the full report is commended. As the result of these trials in which quite 50,000 kilometres were run it is concluded that the car performed very satisfactorily on these alcohol fuels for a period of five years. No difficulty was encountered in starting except when the engine carburetion and ignition systems were faulty and when the driver improperly used the choke. As much power as could be produced with gasoline was obtained with the alcohol fuels. No sticking of the piston valves was noted. The mileage increased as the amount of gasoline increased in the mixture; thus with the nearly straight alcohol fuels the mileage was only from 8·9 to 9·8 miles per gallon, while with the gasoline mixtures the mileage rose to 11·3, 12·7, 14·4, 15·3, 16 and 17·4 as the gasoline percentage rose from 10 to 30, 50, 70, 80

and 90 per cent. respectively. For the proper utilisation of nearly straight alcohol proper adjustment of carburetion and ignition and care in manipulating the parts which control these systems are specially mentioned as requirements. A. K. Y.

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Some Trials of Citrus Budding Methods.—Is it essential in the budding of orange or other citrus seedlings to remove completely from the inside of the bud shield all adhering wood tissue before inserting it in the T-cut of the stock or can it be left on without detriment or with advantage? It is generally believed that the wood tissue should be carefully removed and only the smooth inside of the young bark should be brought into union with the similar tissue of the stock, if good results should be attained. In practice this careful removal is not always easy, it is certainly slow; and the slipping in of the bud shield too is tricky on account of the lack of rigidity in the shield. From a practical point of view therefore one would welcome a correct answer to the above question, based upon accurately conducted experiments. This has been undertaken under the auspices of the Imperial Council of Agricultural Research on the Fruit Research Station, Anantarajapet, Madras Presidency, and the results are now available (K. C. Naik, *Ind. Jour. Agr. Sci.*, Vol. IX, Pt. IV). Along with this question another point for experiment was also taken up, *viz.*, whether the root stock should be lopped off above the union immediately after the insertion of the bud or after the latter has made some growth. The experiments have been laid out with great care for obtaining significant results which have all been statistically studied and interpreted. It was not possible in practice to ensure what would be considered a very material requirement, *viz.*, that the seedlings used as stocks should be of the same age and of the same degree of growth as judged by their girth. From the trials which have now gone on for two years it is concluded (1) the presence of the wood in the bud shield is a distinct advantage; such retention of wood led to a higher percentage of "take" of the buds, the increase ranging from 32 to 36·51 per cent.; (2) the presence or absence of wood has not affected the period taken for the bud break or for the rapid extension of the bud growth; (3) the primary lopping of the root stock at the time of bud insertion has lowered the "take" of buds in some cases but has stimulated an earlier bud break, both in *chinee* oranges and acid limes, the two citrus varieties used in the experiment; (4) delayed primary lopping of the root stock until the bud growth had extended for a length of not less than two inches resulted in a comparatively rapid extension of the bud growth, in the case of *chinee* oranges. It was also found, though this is only of local application, that the months of July to September were the most favourable seasons for budding. It is stated that the results in regard to the retention of wood in the bud are not in accord with the experience of nurserymen in India, among whom the method of careful removal of the wood is the one generally prevalent. It will be useful to inquire and ascertain if there is any special reason for this preference, especially in the light of the above results and also of the greater ease and speed of the method now recommended. A. K. Y.

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Artificial Insemination of Domestic Animals.—Started many years ago and adopted with a considerable measure of success in the breeding of horses in the U.S.A., and in recent years in the breeding of dairy cattle and sheep in Italy and the U.S.S.R., sufficient progress has evidently been made in its adoption in Italy to justify the holding of a session of the National Assembly of Italian Veterinary Surgeons for Artificial Insemination regularly once in two years, which was decided upon at the last session of the Assembly held in Pavia, Italy, during the current year. It was also resolved at the meeting that the Milan Institute for the study of this subject should set up a permanent committee for the encouragement of research in this field. Plans were also considered for converting these biennial assemblies into International Conferences, for the introduction of regular courses of instruction in these methods in the Veterinary Colleges in the kingdom, for its adoption on an extended basis for the raising of both pure and cross-bred sheep of the Karakal breed, and for the opening of special centres suitably equipped for the purpose. More than a quarter of a century ago, on the stud farm at Kunigal in the Mysore State the method was being tried with the costly imported stallions and recently its possibilities in respect of the raising of Merino crosses with Mysore sheep are being looked into. As a means of getting over some of the serious difficulties connected with this problem of sheep improvement the method holds out promise and a study of the Italian methods in this connection deserves to be taken up in India. A. K. Y.

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***Asura* Culture of Chota Nagpur.**—Some of the large number of prehistoric building sites and graveyards scattered all over Chota Nagpur, particularly in the Ranchi and Singhbhum Districts of Bihar, have recently been brought under protection by the Government of India under the Ancient Monuments Preservation Act, according to a press note from Simla.

The sites were first brought to notice by Rai Bahadur Sarat Chandra Roy, who made a preliminary survey and carried out some trial operations. Mr. Roy found that the building sites contained evidence of two or three periods of occupation, ranging from the Neolithic Age to the early Iron Age.

The present-day aboriginal population of Chota Nagpur ascribe the sites to the ancient *Asura* culture. Whether their own ancestors were the authors of this *Asura* culture or whether another race was responsible for this culture, it is difficult to say. It appears probable, however, that the culture of this region is connected, on the one hand with the Copper

Age of North India and on the other, with the Megalithic and Iron Age cultures of South India.

The Government notification is intended to prevent unauthorised excavation on these sites till such time as the Department is able to detail a specialist for such work in Northern India.

* * *

Vegetable Oil for Lamps.—We are glad to report that Mr. D. R. Jogalekar has successfully evolved a lamp which burns on vegetable oils.

As compared with kerosene consuming lamps, he claims a saving of 20 per cent. in cost, while the luminosity attained is of the same order. The utilisation of these vegetable oils as fuel for internal combustion engine, we are told, is receiving the attention of Mr. Jogalekar, whose attention may be invited to the work already in progress in the Alipore Test House, Calcutta, under the auspices of the *Industrial Research Bureau*. It is a matter for great satisfaction that the work has been financed by the Government of Bombay.

* * *

Campaign against Narcotics.—The latest number of the *Bulletin of the Health Organisation of the League of Nations* (Vol. 8, No. 3) contains, among other contributions, a bibliographical report relating to the pharmacodynamic properties of eucodal, dicodide, dilaudide and acedicone. At its session held in May-June 1937, the Advisory Committee on Traffic in Opium and other Dangerous Drugs, discussed the comparative pharmaco-dynamic properties of certain drugs which are being used as substitutes for morphine and decided to ask the secretariat to prepare a memorandum for the information of the Committee. The Health Section accordingly prepared a report which is now published. This brings to light the results of the studies so far made of the anti-spasmodic, analgesic and hypnotic properties of these drugs.

The other contributions in the *Bulletin* are:—Doping: A study of the means employed to raise the level of performance in sport; Rural Dietaries in Europe; and Report on Bread in Several European countries.

* * *

The Government of India have under consideration proposals for making permanent the **Agricultural Meteorology Section** of the Meteorological Department, which is now financed by the *Imperial Council of Agricultural Research*.

The Section is concerned principally with studies relating to the effect of weather on soil and crops and has a number of experiments on hand. It acts as a *liaison* between meteorology and agriculture by helping agricultural workers in setting up farm observatories, by training their assistants deputed to Poona, and by calibrating or repairing their meteorological instruments when sent to Poona. Special attention is being given to officers in charge of the locust, dry-farming, sugarcane and cereal rust research schemes. An important aspect of the *liaison* activity is to discover the types of weather forecasts and warnings that will be most useful to the farmer generally, as for example, heavy or untimely rainfall, cold wave warnings, etc.

* * *

Island Observatories in Indian Seas.—The question of starting pilot balloon observatories in some of the islands in the Indian Seas is under the consideration of the Meteorological Department of the Government of India.

A beginning was made in April this year when steps were taken to open a station in Car Nicobar Island. An officer was also deputed to visit Laccadive Islands to report on the possibilities of starting a pilot balloon observatory at Amini Devi or Minicoy.

The work of marine meteorology is growing every year. The Department held three meetings with ships' officers and ships' and shore Wireless Telegraph officers in Bombay and two with ships' officers in Calcutta last year, at which experiences and views were exchanged on the Department's service to ships.

Storm warnings for the Bay of Bengal and the ports around it are issued from the Meteorological Office at Calcutta and those for the Arabian Sea from the Headquarters office at Poona. The latest information about weather is supplied to shipping at sea by means of wireless weather bulletins issued from coastal radio stations twice daily on ordinary undisturbed days and more frequently on disturbed days.

The chief sources of marine data are wireless messages from ships at sea and extracts from weather logs of ships calling at the principal ports.

* * *

The Photo-Litho Office of the Survey of India, founded in 1889 by Major-General James Waterhouse, I.A., the celebrated authority on photography, who held charge of the map reproduction of the Survey of India, celebrated its Jubilee last month. The Office is situated in Calcutta and it was here that the first postage stamps of India were lithographed in the early fifties.

A press note issued from Simla draws attention to the main activities of this Department of the Survey of India. The Office employs 300 skilled workers and "More than 3,000,000 impressions are pulled in the machines annually and the value of the annual output at office rates is over Rs. 3,00,000.

"Of the original contributions of the Photo-Litho Office towards development of new ideas and modern methods, mention may be made of the direct zinc printing process now known throughout the world as the 'Vandyke Process' which was evolved at this Office and is named after the late Mr. F. R. Vandyke, Manager of its Lithographic Branch, who was responsible for the discovery.

"An experimental section has been instituted in the Office for research on its own account, where original investigations are being continued."

* * *

Progress of Irrigation in India.—According to the annual review of Irrigation in India, just issued, over one-eighth of the total cultivated area in British India—about 32¼ million acres—are annually irrigated by State works alone. The capital outlay on Irrigation and navigation works amounts to Rs. 154 crores, the working expenses to about Rs. 5 crores and the gross revenue to about 14½ crores, with a net return of 6·09 per cent.

275 Irrigation schemes are in operation in British India, of which 70 are of a major description. Nearly a third are classified as productive and the rest, which have been constructed primarily for the protection of tracts with precarious rainfall, as unproductive.

Of the total irrigated area, 12 million acres are in the Punjab. About 86 per cent. of the total area or about 4½ million acres, is under irrigation in Sind. Madras has 7¼ million acres under irrigation and the United Provinces about 4 million acres.

Of the important works, recently completed, mention may be made of the Kattalai Scheme in Madras, which cost over Rs. 37 lakhs and the Haveli Project in the Punjab, since completed at a cost of about Rs. 4½ crores. A Project for impounding the waters of the Tungabhadra is under consideration.

A contour survey in the central and western parts of Bengal is being carried out. Other important works on hand are the Nira Right Bank Canal works in Bombay, the remodelling of the Ganges Canal Branches in the United Provinces and the Quetta Storm water drainage and embankment project in Baluchistan.

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Scientific Expedition to Central Pacific.—Further details regarding the personnel of the Expedition sponsored jointly by the *National Geographic Society* and the *University of Virginia* (*cf.* this *Journal*, 1939, 8, 391) are now available through the courtesy of the *National Geographic Society*. Dr. Charles S. Piggot, well known for his studies on the silt samples from the ocean bottoms, is a member of the expedition. His amazing apparatus for securing samples of mud from the ocean bottom, consists of a cannon which is loaded with a charge of powder and a projectile, which consists of a hollow metal tube ten feet long. "Lowered to the bottom, the cannon goes off automatically. The force of the explosion drives the hollow tube down into the mud. When it is pulled to the surface it contains a cross-section of silt that has been deposited gradually over a period of thousands of years. Studying this cross-section, scientists can reconstruct from it the geological history of the ocean bottom extending back for many ages."

Dr. Maurice Ewing, Professor of Physics, Lehigh University, Bethlehem, Pennsylvania, is another member of the Expedition, who will be engaged in the study of the ocean bottom by means of his ingenious "artificial earthquake" apparatus. The quakes are produced by small "time bombs" which are sunk to the bottom of the sea and exploded automatically by clockwork. "The explosions cause vibration in the sea bottom like those produced by earthquakes. Automatic recording devices are sunk to the bottom at a considerable distance from the bombs. When a bomb explodes, the sound vibrations travel down through the sediment to bed rock, through the rock in a horizontal direction, and up again through the sediment. The vibrations are picked up by microphones in the recording devices, and cause beams of light to vibrate. An automatic movie camera in the recorder photographs the vibrations of the light beam, and the elapsed time between the explosion and the arrival of the sound in the recorder is noted.

"From this record Prof. Ewing can calculate the thickness of the sediment through which the sound vibrations have travelled. He also can determine the type of sediment—how far it has progressed towards hardening into rock—because sound vibrations move more slowly through soft sediments and more rapidly through harder ones."

* * *

Shortite: a new mineral.—The United States Department of the Interior has announced the discovery of a new mineral, officially named "shortite".

Composed of a double carbonate of sodium and calcium, the new mineral was found and identified by J. J. Fahey, a chemist in the American Geological Survey Laboratory. It was discovered as disseminated, well-formed crystals in sections of core from an oil and gas well, drilled in Sweetwater County, Wyoming, at depths of 1,250 to 1,800 feet below the earth's surface. Shortite was named in honour of Dr. M. N. Short, a former geologist of the Survey, who now is Professor of Optical Mineralogy at the University of Arizona.

—(*Chemical Age*, 1939, p. 168.)

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University of Mysore.—The decision of the University of Mysore to institute post-secondary *diploma course in sericulture* from the year 1940, breaks new ground in the matter of textile technical education in India. At present no diploma course in Sericulture under University auspices is given anywhere in this country. The decision of the Mysore University should therefore be regarded as of a pioneering nature. The Mysore State occupies a pre-eminent position in the production of silk in India, and the institution of a regularised course to train specialists, will lead to increased efficiency in the Silk Industry.

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University of Calcutta.—Mr. Kshitischandra Bhattacharyya, M.Sc., has been admitted to the Degree of Doctor of Science in consideration of the thesis entitled "An Examination of the Question of Strain on Mono-cyclic Rings" which was examined by a board consisting of Professor R. Cornubert, Sir Gilbert T. Morgan and Sir W. J. Pope.

* * *

Associateship of the Imperial Dairy Institute.—The question of according formal recognition to the post-graduate course in Animal Husbandry and Dairying given at the **Imperial Dairy Institute, Bangalore**, since 1923, has been under consideration by the Government of India. It has now been decided that those who have in the past satisfactorily completed the course or who may do so in future should be designated as **Associates of the Imperial Dairy Institute.** This title will be denoted by the abbreviation "Assoc.I.D.I.", which the successful post-graduate students will be entitled to affix to their names.

Industrial Notes

Catalogue of Fibre Plant Exhibits.—This publication which has been sponsored by the *Botanical Survey of India*, is a useful bulletin dealing with the fibre plant exhibits, and the usefulness of the volume would have been considerably enhanced if the author had critically appraised the economic value and indicated the extent of availability of these materials. It is earnestly to be hoped that the author will, in his next edition, not only elaborate these points but also avoid the embarrassingly long four-page corrigendum and addendum.

Laboratories of the British Non-Ferrous Metals Research Association, London.—This is a national organization of producers, manufacturers and users of non-ferrous metals established in 1920 for the promotion of scientific knowledge in Industry. The Association owns a subscribing membership of about 300 and administers a total annual income exceeding £30,000 which is partly subsidised by the *Department of Scientific and Industrial Research.* Since 1930, the council has centralised the administrative, technical and information services of the Association in one building in London near Euston Station. Although much of the Association's research has since been gradually transferred to this centre, a certain amount of investigation is still carried on extra-murally, to take advantage of the special facilities obtaining in other laboratories. The centralisation succeeded in stimulating the growth and expansion of the activities of the Association to such an extent that the council in 1937, approved a substantial capital expenditure on additional laboratory accommodation. The new laboratories which were completed in 1939 are described in a profusely illustrated and well got up booklet which also includes information on the Association's organisation and the type of work carried out, for the benefit of its members.

The International Tin Research and Development Council.—The Council was sponsored some seven years ago by the Governments of various tin-producing areas throughout the world, for the purpose of acquiring and disseminating scientific and technical knowledge relating to tin, its alloys and chemical compounds. The researches and other activities of the council are planned to discover and develop new industrial applications of tin, to improve existing products and processes and to assist tin consumers in overcoming their technical difficulties and problems. This project is directed and financed by the united efforts of numerous political entities.

The research work is widely dispersed at several centres, Aberdeen, Berlin, Birmingham, Cambridge, Columbus (Ohio), Delft, The Hague, Liverpool, London, Manchester, Munich, Paris, Sheffield, Swansea and Utrecht.

At the commencement of the year 1939, the council occupied its permanent headquarters in the vicinity of London, which houses the administrative offices, the technical bureau and the library and the metallurgical and chemical laboratory.

The council issues a quarterly journal under the caption *"Tin and Its Uses"*, which is sent free to those who are interested in the subject. The publication contains contributions of interest to the chemical engineering, moulding, sheet metal working, canning and packing industries. In addition to this quarterly, the council issues special bulletins on subjects like electro-tinning, soldering, tin alloys in dental practice, etc. The international collaboration in the field of pure and applied research on tin secured by the council, is one that should be extended to other economic products of the world.

Titanium Oxide as a By-product in the Manufacture of "Alumina-Ferric" from Bauxite.—The residual mud remaining after treatment of Indian bauxite with sulphuric acid in the manufacture of Alumina-Ferric, contains as much as 35–40% TiO_2 and forms a valuable raw material for the extraction of titanium oxide. The process developed my Mr. S. C. Chakravarty, which is an adaptation of that employed in the manufacture of the oxide from ilmenite, is described in a *Bulletin* (No. 15) of the *Industrial Research Bureau* of the Government of India. Mr. Chakravarty has successfully recovered from his pilot plant operations a product containing 98–99% TiO_2, the yield being about 42% on the weight of the mud. The cost is reckoned at Rs. 35 per cwt., the current market rate being about Rs. 56. The oxide is extensively employed as a pigment in paints, in soap-making and in ceramics and as a component of vitrified enamels.

Announcements

Benares Hindu University.—A Prize called Chandulal Chotalal Mehta Prize consisting of the interest on Rs. 5,000 for one year or of books of the like value to be selected by the winner, shall be awarded for the best essay on the subject "The Population and Production in India".

Competitors shall be graduates of the Benares Hindu University of not more than seven years' standing from the date of the graduation.

The essay must be sent to the Registrar, *on or before the fourth Monday in July 1941.* Each essay shall be designated by a motto instead of the writer's name and shall be accompanied by a sealed cover containing the name of the competitor, his university standing, full address and a declaration that the essay is *bona-fide* his own composition.

The Prize shall not be awarded for an

essay which, in the opinion of the Judges, does not show research or originality of treatment.

The Twenty-third Annual Conference of the **Indian Economic Association** will be held at Allahabad under the auspices of the Allahabad University from the 29th to the 31st December 1939.

Indian Statistical Conference.—The third session of the Indian Statistical Conference will be held in Madras in the first week of January 1940. It has been provisionally arranged that the Conference will be opened by H. E. the Governor of Madras on the 3rd January. On the invitation of the Mysore University, arrangements have also been made for holding a special session in Mysore, possibly on the 6th and 7th January.

In Madras, the work of the Conference will be carried on in active co-operation with the Indian Science Congress as in previous years. Arrangements have been made for joint meetings with the Sections of Mathematics, Physics, Agriculture, and possibly the Section of Medicine and Public Health. There will also be a special session on Economic Statistics.

The Hon. Mr. V. V. Giri, Minister of Labour and Industries, Government of Madras, will preside over a special discussion on "Labour Statistics".

Papers and scientific contributions should be sent so as to reach the Honorary Secretary, Indian Statistical Institute, Statistical Laboratory, Calcutta, before December 15.

We have been informed by the Secretary, **Central Board of Irrigation** in India, Simla, that with reference to the statement:

> "Discussion on these two subjects seems to have lead nowhere"

[referring to (1) the role of reservoirs in River Flood Control, and (2) meandering of rivers] occurring in the review of the Annual Report of the Central Board of Irrigation for the year 1936–37 (this *Journal*, 1939, 8, 24, col. 2), the study of these problems is a progressive one carried on from year to year in which way valuable data is gradually accumulated and analysed (*cf.* Report for 1937–38, pp. 64 and 93, and 68 and 108).

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We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, No. 2.

"Agricultural Gazette of N.S.W.," Vol. 50, No. 9.

"The Philippine Agriculturist," Vol. 28, No. 4.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 8.

"Indian Journal of Agricultural Science," Vol. 9, Pt. 4.

"Allahabad Farmer," Vol. 13, No. 5.

"Journal of the Institute of Brewing," Vol. 45, No. 9.

"Journal of the Indian Botanical Society," Vol. 18, No. 2.

"Journal of Chemical Physics," Vol. 7, No. 8.

"Journal of the Indian Chemical Society," Vol. 16, Nos. 7–8.

"Chemical Age," Vol. 41, Nos. 1043–44, 1048–53.

"Comptes Rendus (Doklady)," Vol. 23, Nos. 8 and 9 and Vol. 24, Nos. 1–2.

"Experiment Station Record," Vol. 81, Nos. 1 and 2.

"Indian Forester," Vol. 65, Nos. 9 and 10.

"Transactions of the Faraday Society," Vol. 35, Nos. 220 and 221.

"Genetics," Vol. 24, No. 3.

"Bulletin of Health Organization (League of Nations)," Vol. 8, No. 3.

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The Indian Chemical Industry

THE ten weeks since the declaration of the War, have been witnessing a steady inflation in the price of drugs and chemicals in this country. The manufacturing industries whose maintenance is largely dependent upon the import of foreign accessories and raw materials, have already begun to feel the pinch of a diminishing supply of their essential needs. The Conference of Chemical Manufacturers held recently at Calcutta, under the auspices of the *Indian Chemical Manufacturers' Association,* has focussed the attention of the public on the imminent shortage of drugs and chemicals in India. The country has now become painfully conscious of its large dependence upon foreign sources for its supply of the principal drugs and chemicals.

The country was confronted with a similar crisis twenty-five years ago, during the Great War of 1914–18. Since then, the Indian Chemical Industry has made some progress; the pharmaceutical industry, for instance, has been trying to establish itself and has survived keen foreign competition; small nuclei of heavy chemical industry which now exist in the country, are manufacturing sulphuric acid; one or two works for the manufacture of alkali, are also under active consideration. But these could satisfy only a small fraction of the growing needs of the country. At the moment, India consumes, annually, about five crores rupees worth of drugs and chemicals, of which at least seventy-five per cent. is imported from abroad.

The Chemical Industries in India group themselves into three main classes:—(1) Those which are in the process of establishing themselves on a fairly firm foundation,

(2) those which are yet in their infancy and which, on that account, require careful protection and consolidation and (3) those which await exploitation. The pharmaceutical industry which falls under the first group, is in immediate need of rapid expansion to satisfy the increased demand caused by the total stoppage or partial curtailment of imports. The development of this industry, which is urgent, could have been easily secured, if we were not obliged to depend upon foreign sources even for some of the basic raw materials. The textile industry is faced with a similar situation because of the rapidly diminishing supplies of wetting, bleaching and dyeing materials.

Many of the industrial enterprises now flourishing in the country can continue to function only if an unrestricted supply of the imported raw materials and spares of manufacturing machinery is ensured. It would be difficult to point out one single chemical industry in this country which can be considered self-sufficient and which will not be more or less crippled for want of foreign supplies. This unhappy state of affairs is the natural consequence of the policy of wholesale transplantation of industries which the country has been adopting in the past. There have been several instances in which even erecting engineers and technical experts have been imported to run the industry. The adoption of such a policy was no doubt necessary at a time when the industries were still undeveloped. Very few of the industries can claim to have originated through our own creative effort, which has yet to play its part in the future development of industries.

It may be said that the country is now on the threshold of the second stage when the creative faculty, latent in the country, should be stimulated and mobilised for the promotion of industrial advancement. This is not going to be an easy task for a country which has so far lacked competent, disinterested and broad-minded leadership in this field of national economy.

The next phase of industrial development in this country should consist in the consolidation of the existing industries; they should be rendered less and less dependent upon foreign imports. Subsidiary industries helping to produce accessories and intermediates should be organised. The possibility of utilising substitutes of Indian origin should be intensively and systematically explored. In the domain of pharmaceuticals, for example, it would be easy to find substitutes, perhaps more efficacious, but the industry is yoked under a highly conservative British Pharmacopœia. It is for the *Indian Medical Research Council* to take up this matter and examine the situation.

The designing and fabrication of chemical plant and machinery leading to the establishment of chemical engineering industries in the country, should be immediately taken up for serious consideration. The country possesses the necessary equipment and talent; we have large foundries and machine shops and skilled and capable workmanship is available. We may be lacking in some of the specialised materials of construction like stainless steels and special alloys, but we could, for the moment, do without them. It is a matter of profound regret that the Central Government could not see their way to subsidise Sir M. Visvesvaraya's scheme for founding an automobile industry in this country, as this would have facilitated the establishment of the chemical engineering

industries by providing the necessary background. The present opportunity should not be lost in laying the foundations of this industry on sound lines.

The Government of India have suggested that Indian Manufacturers might prepare a consolidated statement of their requirements of heavy chemicals and obtain them through Messrs. *Imperial Chemical Industries,* who are in close touch with the world markets with regard to these commodities. While this arrangement will provide a temporary and easy solution to the problem, this remedy will, in the long run, prove worse than the disease, as it will only serve to perpetuate our dependence on foreign supplies to nourish our industries. The Central Government should take a broader and more generous view of the problem and help the establishment of these key industries in the country. Such a step would be in the best interests not only of India, but also of the Empire. The industrial prosperity of Canada, Australia and other Dominions, has proved to be a source of great strength to Britain in the present crisis; flourishing chemical and engineering industries in India would, in a similar manner, constitute great assets to Britain in war as well as in peace.

It is for the Central and Provincial Governments to move in the matter of organising and mobilising the material resources and technical talent and help the country to enter on the second phase of industrial development. It would be a grievous mistake if the Government should lose this opportunity. A Board of Scientific and Industrial Research or a National Research Council should be constituted to deal with all the aspects of the problem. The *Industrial Research Bureau* which is now miserably staffed and financially starved, may be reconstituted into a bigger and more comprehensive body and provided with ample funds to finance schemes of industrial research.

Biological Abstracts

THE announcement that *Biological Abstracts* will undertake a more complete abstracting of current literature in bioclimatology and biometeorology will be welcomed by research workers interested in medicine, public health, ecology, agriculture, forestry, botany or zoology, geography and other sciences. The increasing interest in climatic and meteorological factors in their relation to biology, medicine and agriculture is one of the significant trends of modern science. Ecologists, foresters, horticulturists and entomologists are all concerned with the interrelationships between climatic and meteorological factors on the one hand and the organism with which they work, on the other. Increasing attention is now being paid to bioclimatology and biometeorology in various countries and the situation necessitates the ushering in of a mechanism for bringing together the scattered literature in this field. The abstracting journals of broad scope like *Biological Abstracts*, are admirably suited for such a synthesis and by inaugurating this service *Biological Abstracts* will be fulfilling a very important function.

The section Bioclimatology-Biometeorology will appear within the section Ecology in *Biological Abstracts,* and will be edited by Mr. Robert G. Stone of the Blue Hill Observatory, Harvard University. Under the sectional publication plan, this material will be found not only under Section A, "Abstracts of General Biology", but also under Section B, "Abstracts of Experimental Animal Biology", Section D, "Abstracts of Plant Sciences" and Section E, "Abstracts of Animal Sciences".

Some Aspects of the Chemistry of the Vibrios

By Richard W. Linton

(Department of Pathology, Cornel University Medical College, New York)

I PROPOSE to review in this paper a series of researches on the cholera vibrio which were carried out in India under my direction between 1931 and 1938. They were supported by grants from the *Indian Research Fund Association,* and the material upon which the paper is based was published in the *Indian Journal of Medical Research* during those years.

When the study commenced in 1931 we were faced with a heterogeneous mass of vibrios, some named and some numbered, some isolated years before and some newly isolated, from highly fatal epidemics or mild cases, some from the beginning and some from the end of epidemics, others from carriers or from water. With the information then available it was impossible to make any useful differentiation of these vibrios or to say which was dangerous and of epidemiological importance and which was harmless.

Another aspect of interest in the cholera problem at that time was the question of variation. Workers in India were then much interested in bacteriophage, which was being widely used as a therapeutic agent, and under the influence of 'phage, in the laboratory at least, the vibrio appeared capable of an extraordinary range of variation; and these variants were themselves objects of speculation as to their relation to cholera.

At that time we did not have the advantage of any useful knowledge of vibrio serology, such as has been obtained during more recent years through the work of Gardner and Venkatraman and Bruce White, although this work itself, as is now becoming evident, was too narrowly based to stand up under accumulating field experiences. In our own work, it was accordingly necessary to choose strains at random, since there was only the slightest information, at first, as to what their potentialities might be in the cholera problem.

Our first work was on the isolation of polysaccharides from the vibrios; later as the work expanded we undertook the study of vibrio proteins, of vibrio metabolism and finally of the chemical basis of vibrio variation.

Leaving aside the technical details of the isolations, I may point out that of over 300 vibrio strains from all sources, three polysaccharides were obtained. As far as we were able to carry the analysis, these appeared to be made up of the following constituents: (1) Galactose plus an aldobionic acid consisting of galactose and glucuronic acid; (2) Arabinose plus an aldobionic acid consisting of galactose and glucuronic acid; (3) Glucose alone, no aldobionic acid. The first two of these were reported in 1932 and the last in 1935, although it is probable that this polysaccharide was identical with one isolated by Jermoljewa and Bujanowskaja in 1930, who tentatively identified glucose in the hydrolysis products. These polysaccharides vary in nitrogen content between 3% and 6%, with about 0·6% of amino nitrogen. Landsteiner and Levine found a nitrogen content of 4·3% in the vibrio polysaccharide which they isolated. These structures are acetylated in the cell, and have distinctly different specific rotations.

In the same large group of vibrios, a study of the proteins was next undertaken. The well-known complexity of the proteins seemed to afford an opportunity for an almost unlimited capacity to break down into a number of fractions. Rather than do this, however, we chose to take the protein as a whole, and see if any differences could be found between proteins from various vibrios from different sources. We applied Woodman's technique to these proteins, and found that no matter how many vibrios we studied we obtained only two curves, and that these curves correlated with the source in nature, or one might say, with the epidemiological source of the organisms.

We had thus three polysaccharides and two proteins among the vibrio group as a whole. Each individual vibrio appeared to be made up of one polysaccharide and one protein. We accordingly had the possibility of six groups among these organisms,

and over the course of several years, all six of these groups were found. For example, after three of the groups had been formed, it was possible to predict the existence of a fourth group, and several months afterwards upon the analysis of some carrier strains from El Tor in Egypt, vibrios were found which conformed to this chemical composition. In the same way, the discovery of the glucose-containing polysaccharide, which came after the work had been in progress for three years, permitted us to predict the existence of the sixth group, and eighteen months later on analysing some vibrios from China, this group was found.

Having thus been led to form groups and divide the vibrios according to their chemical structure, it was important for our hypothesis to pursue other lines to see if we could strengthen our work, or if we should modify our conception. These further researches, which in large part went on at the same time as the chemical analyses, and were an integral part of them, followed three lines: evidence from epidemiology; evidence from the metabolic activity of the vibrios; and evidence from variation.

The evidence from source or epidemiology showed us that vibrios having the chemical structure of groups I or II invariably came from cholera cases, in recent isolation; that is, not from old laboratory strains which might have come from cases years previously; also in these groups were vibrios from people who had been in recent contact with cases, in the same house for example. Group II vibrios are rather rare in our series, and hardly appear in Calcutta during the annual cholera epidemic at all; on the other hand, their isolation from highly fatal epidemics in Assam indicates that they have an important part in some places in the disease. Strains from water were generally found to have the group III structure, although, as one would expect, since cholera is often a water-borne disease, vibrios of the first two groups were occasionally found. Strains from chronic carriers, from El Tor and from carriers in India and China were found to have the group IV or V structure; specifically, the El Tor strains were of group IV structure. It was of interest to study these strains and to show that they were related to the cholera vibrios of group I by having the same polysaccharide, and to the water vibrios by having the same protein. Our analysis showed that chemically the strains were the same in the earlier isolations at El Tor thirty-five years ago, and the isolations of 1930–32. Old laboratory strains from cases, or case strains which had been made to vary artificially generally were found to possess the group VI structure. Accordingly before the work was ended, it was possible to predict with a good deal of accuracy just what chemical structure a strain would possess, when its source was known. In short we had a constancy of protein and polysaccharide in relation to source which strengthened the validity of the groups.

The evidence from metabolism consisted in brief of differences which were constantly present between the different groups, although the separation was not as complete as it was on the basis of chemical structure. Anaerobic glycolysis appeared to be constant in all the vibrios, but there existed regular differences in respiration and aerobic glycolysis. It was interesting to find that the group IV carrier strains did not show any aerobic glycolysis.

Altogether, something over two hundred strains were studied by metabolism methods, and it was found that 98% of the case strains and 100% of the contact strains fell into the same group and chemical analysis showed that these were groups I and II of the chemical classification, or, if the strain had been for some time in the laboratory, group VI. Strains with another level of metabolism were carrier strains, and with a third were water vibrios. It appeared again that we had differences between vibrios consistent with the groups which appeared on the basis of the chemical analyses.

The subject of variation in the vibrios and its chemical basis is a large one, and occupied us for several years. In general, the method was to take a strain of known chemical composition, metabolism, colony form, biochemical reactions, serological reactions, etc., and either study its spontaneous dissociants, or force dissociation by any of the well-known methods and then study these dissociants in the same way. As an example of spontaneous dissociation, I may give the following: In April 1935, chemical analysis of strain 1200, which had been isolated in the previous December, showed that it belonged to group VI, *i.e.*,

its polysaccharide was of the glucose-containing type. In May 1936, thirteen months later, after undergoing routine sub-cultures, a second analysis was made and indicated the presence of a large amount of galactose accompanied by some glucose in the hydrolysate of the polysaccharide. A third analysis in January 1937, twenty-five months after isolation, showed only galactose in the hydrolysate. At the same time, the strain had shifted its serological reaction and now agglutinated only with an antiserum to another galactose-containing organism, whereas on first isolation it had reacted only with antiserum to a glucose-containing organism. In other words, the shift in its chemical structure had been reflected in its serological reactions.

Very many experiments of this type, and also with single-cell cultures and forced or spontaneous dissociation showed us that variation had a chemical basis in the vibrios. In the case of single-cell cultures, we began with a culture descended from a single cell and having a certain set of characteristics: biochemical, cultural, serological; and a certain chemical structure. At the end of the experiment we had produced from this culture a new strain having another set of biochemical, cultural and serological characteristics, and a different chemical structure. It followed that the new strain fell into a different chemical group than the old, and I wish to emphasize that all the characteristics of the new strain were similar to those of other strains in the chemical group into which it now fell. In other words, the changes in chemical composition, biochemical reactions, cultural and serological properties are correlated.

It is of interest to note further that while the vibrios vary in this correlated way, they always remain within the framework of the six chemical groups, that is, within the framework of the two proteins and the three polysaccharides. Within these limits the powers of synthesis and variation are considerable, but the organisms appear incapable of giving rise to any other chemical constituents. The conception is that of a strictly limited capacity for transformation.

To return, in closing, to the present situation in the vibrio group in contrast to that which I outlined at the beginning of this paper, we have been able to divide the vibrios into a small number of groups, which correlate with their epidemiology and metabolic activity. This result is in contrast to the large number of heterogeneous groups which have always resulted from purely serological attempts at classification, a number which varied directly with the number of strains which were being studied. For recent examples of this statement, the papers of Taylor, Pundit and Read, and of Mertens and Mochtar may be consulted. The former found that 33 "O" antisera were insufficient to classify 558 vibrio strains, while the latter could not classify 32 strains using 17 antisera. Finally, some order has been brought into the subject of vibrio variation, the limits of this variation appear to have been established, and transformation of vibrio strains has been shown to occur in the laboratory.

Any account of our research would be incomplete without mention of those whose unceasing efforts over a period of years enabled the facts to be elucidated, and I accordingly take pleasure in adding to this paper the names of Dr. D. L. Shrivastava, Dr. B. N. Mitra, Dr. S. C. Seal, Jemadar Harwant Singh, and Messrs. S. P. Mookerji and D. N. Mullick.

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The Problem of Opium Addiction in India and Its Treatment

By Brevet-Col. R. N. Chopra, C.I.E., I.M.S. (R.), M.A., M.D., Sc.D. (Cantab.), F.R.C.P. (Lond.)
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OPIUM and poppy were introduced on the west coast about the ninth century A.D., by the advent of the Mohammedan traders, and opiates soon came into use. A study of records shows that during the period of the Moghul Empire, alcoholic beverages, opiates and hemp drugs were freely used. A decoction made from poppy capsules known as *koknar* was extensively used all over India. Opium, on account of its stronger effects, appears to have taken a great hold of the people.

Most of the raw opium sold in this country is used for addiction purposes in one form or another. The present use of opium in India may be considered under five main headings:—(*i*) Opium eating, (*ii*) opium smoking, (*iii*) poppy drinking, (*iv*) addiction to opium alkaloids, and (*v*) administration of opium to infants.

(*i*) *Eating of opium* is the favourite method of indulging in the drug. The common practice is either to pound the drug, mix it with water (*Kasumba*) and drink it or take it in the form of a pill. From the figures I have collected all over India it appears that the consumption of opium, if the country is taken as a whole, is very low, but curiously enough there are certain areas where it is very high. The areas of high consumption are Calcutta, Hooghly, Howrah and 24 Parganas in Bengal Presidency; East Godavari and West Godavari in the Madras Presidency; Ferozepore, Lahore, Ludhiana and Amritsar in the Punjab; Bombay town, Ahmedabad and Broach in Bombay Presidency; Amraoti, Akola and Balaghat in the Central Provinces; Cawnpore, Benares and Lucknow in the United Provinces; Assam as a whole shows high consumption, where the districts of Lakhimpur, Sibsagar, Nowgong, Darrang and Kamrup are noted for very high consumption of this drug. The highest consumption rate recorded in India is in the Sadiya Frontier Tract, where it is 94 seers per 10,000 of population per annum. The high figures are due to smoking of the drug, which necessitates much larger quantities of opium per head. On the other hand, there are extensive areas in all the provinces where consumption is very low, *i.e.*, even less than 12 lbs. or approximately 6 seers per 10,000 of population per annum, a standard laid down by the League of Nations for Medical and scientific needs of the people. Such areas are now on the increase. According to the survey by the author and his collaborators it is estimated that there are at least between one to five and a half million opium addicts in India, *i.e.*, approximately 0·5 to 1 per cent. of the total population.

(*ii*) *Opium smoking.*—It is not clear how this habit came into this country; probably it was introduced as a part of tobacco smoking by the Chinese or Mohammedan invaders but fortunately it never assumed such a menacing aspect as it did in China. Our present enquiries show that the habit of smoking opium in one form or other is met with on a small scale in many of the large towns in India. It would appear that the habit of smoking opium has considerably declined during the last thirty years. In most parts of India, therefore, this is a very uncommon method of consumption of opium at the present time. The only exceptions to this rule are Assam and the Central Provinces where opium smoking is almost as common as opium eating. According to a recent survey we have carried out (1938) it is estimated that at present there are between 62,000 to 83,200 opium smokers in India, out of which 25,000 are from Assam and 15,000 from the Central Provinces and Berar.

(*iii*) *Drinking of beverages made from poppy heads (unlanced capsules of* Papaver somniferum).—During the sixteenth, seventeenth and eighteenth centuries when the Moghuls were in power in India, the poppy capsules or 'post' capsules were extensively used to prepare a beverage which had soothing and euphoric effects. The use of poppy beverages has considerably decreased during the last three decades but still exists in a few localities in the Punjab and Rajputana. The effects are almost similar to that of opium eating. There are at present between four to five thousand poppy addicts in India.

(*iv*) *Addiction to opium alkaloids.*—Habitual use of morphine has considerably increased in India during recent years in

certain parts of Northern India. The addiction is usually met with in young persons between the ages of 20 to 25 years. The habit is generally started on account of the euphoric and aphrodisiac properties of the drug. In the beginning this alkaloid was taken almost exclusively by the mouth but recently the injection method has also come into vogue. The physical, mental and moral deterioration sets in much more rapidly than is the case with other forms of opium addiction. Addiction to other alkaloids of opium such as codeine and heroine, etc., is rare in this country.

(*v*) *Administration of opium to infants.*—The practice appears to have been started because of the drug's power of allaying diarrhœa and vomiting, relieving cough and pain, and producing sleep. The only areas where the custom is still extensively prevalent are certain parts of the Central Provinces and Berar and few other industrial areas all over the country. In Berar 75 per cent. of the infants are doped with opium. In the cotton-growing areas the children account for 40 per cent. of the total consumption of opium. The main reason for administering opium to the children are economic; the drug is given to keep the children quiet so as to allow the mother to carry out her work unhampered whether in the factory or in the field. The practice is begun during the first few weeks of the infant's life and is usually discontinued when the child attains the age of two or three years when it begins to play about and can live on ordinary food. The use of opium affects the child's health adversely and hinders its growth. The children receiving opium have an emaciated, unhealthy and toxæmic appearance. They are more liable to catch infections and to attack of epidemic diseases and the mortality rate among them is comparatively high.

Aetiology of Opium Addiction

Social and economic factors play an important part in starting and continuing this habit. The standard of social and hygienic conditions of the working classes in this country is very low. No healthy amusements are available and the workers living under such conditions are in search of some form of diversion which will enable them to forget at least for the time being, the monotony, hardships and worries of their daily existence. Their intellectual development is low, the housing conditions are primitive and overcrowding is general. The above conditions predispose them to the habit as it gives something which enables them to forget their worries. The main direct causes leading to the opium habit as studied in a series of 1,238 addicts were (1935):—(1) Association with other addicts which accounted for 50 per cent. of cases; (2) diseases or minor ailments for which no medical advice was sought, 33·3 per cent.; (3) hard work, worry or strain, 13·3 per cent.; (4) substitute for alcohol, 3·4 per cent.

Physical and Mental Effects

(*a*) *Opium eating.*—From an analytical study of 1,238 opium eaters the following conclusions are drawn: The habitual use of opium and in small doses may not produce marked physical or mental deterioration. Such addicts may keep fit, gain in weight and carry on their ordinary vocations of life efficiently for many years. With larger doses the gastro-intestinal tract becomes seriously disturbed, obstinate constipation alternating with Diarrhœa and loss of appetite supervenes. The addict shows signs of toxæmia, loss in weight, anæmia, sallow colour, etc., and even signs of cachexia. Opium habit is more liable to cause injury to the mental and moral faculties of persons with a nervous diathesis or with nervous irritability than to normal individuals. The common changes observed in such individuals are development of lazy habits, impairment of memory, slow cerebration, lack of self-confidence, selfishness and irritability of temper.

(*b*) *Opium smoking.*—From a careful study of 300 opium smokers the following conclusions are drawn: It has been observed that the Chinese and the Burmese smokers as a rule seem to suffer less than the Indian smokers. They are able as a rule to regulate their dose with precision and keep the daily consumption within limits which would not endanger their earning capacity by causing adverse effects upon their general health. The effects of general unhygienic environments, neglect of general health, lowered standard of living, and the use of a common smoking pipe are responsible for spreading such communicable diseases as syphilis, tuberculosis, pyorrhea alveolaris, amongst the habitues. Their role in causing incapacity amongst the habitues is nevertheless important. In the majority of smokers, the cost of the drug may be as much, or even more, than their earnings,

In order to make both ends meet the habitue tries to stimulate his physical energies by further increasing the dose so as to perform more work which further undermines his health and gradually decreases his working capacity. Eventually there is a complete loss of earning capacity and he is useless to himself and to society.

The confirmed opium smokers as a rule always show marked physical deterioration. The excessive smokers are thin, emaciated persons with sallow or muddy complexion, and dull and sunken eyes. The throat is often bad and constantly subject to attack of tonsilitis, pharyngitis and chronic bronchitis. The appetite decreases and may be lost, the food is not properly assimilated. When the drug has been abused for a long time the sexual impulse is very often deficient and wanting.

Prolonged and excessive smoking produces a lethargic state of mind, dullening of the mental processes, gradual loss of will power, neglect of work, subordination of every interest to the craving. Opium becomes the main object in life.

Biochemical studies.—Biophysical and biochemical properties of the blood serum were studied in opium addicts, when under the effect of opium and during the period of abstinence. The work on the physical properties of the sera of opium addicts shows that the blood of opium addicts becomes hydræmic. During the withdrawal period the hydræmia disappears and the blood becomes more concentrated and this is maintained both during and after the treatment. The lecithin and cholesterol contents of the blood were also determined simultaneously to see if these had any bearing. The results so far obtained indicate: (1) that in the majority of cases, the blood lecithin content is normal though in a few cases it is somewhat lower; (2) that there is an undoubted increase of lecithin in the blood, during the course of lecithin treatment; and (3) that the cholesterol figures are somewhat irregular and seem to bear no direct relation to the actual condition of the addict or to the lecithin contents.

Opium smoking and opium eating.—Smoking and eating of opium are different aspects of the same problem though the former is believed to be more harmful than the latter. The opium smoker needs very much larger quantities of opium to satisfy his cravings than the eater, but in spite of the smaller quantities of the morphine absorbed, the practice appears to be more harmful. The process of preparation is a long one and the actual smoking naturally takes longer time than swallowing of pills or a mixture of opium and water. For these reasons the smoking of opium is very often abandoned during later stages of addiction when the dose has become very large. The abstinence symptoms in case of smokers are more pronounced. The smoking habit more often is the outcome of the euphoric or pleasure-giving effects of the drug, while such causes of the disease as fatigue and old age frequently lead to the habit of eating opium. The increase in dosage in case of smokers is much more rapid, probably due to the fact that the actual amount of morphine absorbed into the system is smaller with each dose. The chemical changes which the constituents of opium undergo by drastic heating during the process of preparation for smoking must also be taken into consideration when comparing the effects. Although their exact nature is not known, it would appear that during the process of heating the effects of the drug become more potent. Also there is no doubt that the effects of non-alkaloidal constituents of the smoke, that is, other products of combustion, also play some part.

Treatment of Opium Addicts

Following the lead given by our biophysical and biochemical researches, a large amount of work has been done in connection with lecithin treatment of opium addicts in the Carmichael Hospital for Tropical Diseases. This treatment has been tried with success on several thousand opium addicts who were taking doses of opium ranging from 45 to 250 grains daily in Upper Assam Valley during the recent prohibition campaign against the drug by the Assam Government. Briefly, the procedure adopted is as follows: Opium is suddenly withdrawn and a dose of 1–3 grains of calomel is given at bed time which is followed by a dose of salts next morning. The last named is repeated every morning for the next few days to eliminate opium from the system and to help the liver to function. On the second day after withdrawal, lecithin is given in 20-grain doses thrice daily in the form of a pill. In a certain number of cases lecithin by mouth causes nausea, and in such cases,

the drug may be given in the form of a colloidal solution by injection, the usual dose being 2 c.c. of 1 per cent. solution twice daily. Experience has shown that lecithin when given by injection, acts better than when it is given by the mouth. Besides this, the amount required to produce the desired effect is comparatively small and consequently the cost of treatment is considerably reduced. During the period of abstinence the patient is encouraged to take plenty of fluids and glucose by the mouth as these greatly ameliorate the symptoms of withdrawal. He is also given 25 c.c. of 25 per cent. glucose along with 10 c.c. of 10 per cent. calcium gluconate by the intravenous route during the first five days of the treatment. Glucose by the intravenous route helps in the elimination of the opium alkaloids and stimulates the glycogenic function of the liver. It also serves as a ready food for the heart during the withdrawal period when all other food is generally refused. Calcium controls the muscular cramps which are commonly met with during the period of abstinence.

The duration of the treatment varies from seven to twelve days according to the dose, the duration of addiction and the age of the addict. Such untoward symptoms as low blood pressure and feeble pulse are combated by means of cardiac stimulants. Adrenaline given in doses of 5 to 10 minims checks the tendency to nausea and vomiting. Diarrhœa which is often a troublesome symptom is controlled by administration of such simple drugs as bismuth carbonate and aromatic chalk powder in 10 to 15 grain doses. The cramps and pains all over the body are treated by massage and administration of analgesics such as aspirin, phenacetine and veramon. In cases where the pains are very severe and unbearable, intramuscular injections of 2 c.c. of novalgin (Bayer) often give relief. Injections of 1/100 grain of hyoscine hydrobromide were tried but with little effect. Insomnia is a very troublesome symptom during the first few days of the withdrawal period and sometimes for several days after. Medinal in doses of 7½ grains is often effective in inducing three to five hours sleep. In cases where insomnia did not yield to barbiturates, alcoholic extract of *Rauwolfia serpentina* in doses of 10–20 minims was effective. Lecithin is usually stopped 4 to 5 days after withdrawal of the drug and the patient is put on a tonic mixture containing iron, arsenic and strychnine.

With this treatment it has been shown that the discomfort due to the withdrawal of the drug is reduced to the minimum and most of the patients gradually develop a dislike for the drug. The mental outlook of the addicts also shows a remarkable change. Addicts who were definitely apathetic and morose before the start of the treatment have been observed to become cheerful and energetic and gradually begin to take an intelligent interest in their surroundings. They become more sociable, docile and respectful and show inclination for work. A change in the physical appearance is also observed in some cases. This is probably due to the improvement in the general health and better digestion and inclination for food.

The morphine content of the urine of addicts was determined daily during different stages of treatment under hospital conditions. Morphine could be detected in decreasing amounts during 4–5 days after complete withdrawal of opium. It could not be detected in the urine after this period.

The total course of treatment varies from 7 to 12 days and during this period the change in the condition of the addict, is marvellous. The patients treated in the hospital are kept under further observation for a period varying from 4 to 12 weeks in order to rehabilitate and change and train them to the new environment and to watch for any relapse occurring. The period of rehabilitation and rebuilding of the personality of an addict may sometimes extend to 6 months.

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LETTERS TO THE EDITOR

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Effect of Crystal Orientation on the Raman Spectrum of Calcite

THE importance of studying the Raman effect in single crystals by adopting directional excitation has been stressed elsewhere. Much work on these lines has not yet been done. A recent paper by Nedungadi[1] contains all the necessary references to the earlier work and describes very fully the results obtained by him in the case of sodium nitrate. The author has also been engaged in studying the same phenomenon in the completely analogous case of calcite. The present note containing a preliminary account of the results obtained may be of interest as it closely follows Nedungadi's publication.

A one-inch cube of calcite cut in such a manner that the optic axis is parallel to one of its edges and having all its faces polished has been used in the present investigation. We shall designate the direction of incident light by OX, the direction of scattered light by OY and the three edges of the crystal are always along OX, OY and OZ. Twelve pictures, at the rate of four for each orientation of the optic axis, have been taken. The incident light is always linearly polarised and the scattered light is analysed with the help of a suitably oriented double-image prism. Visual estimates of the intensities are tabulated in Table I. This corresponds to Table III of Nedungadi's paper.

TABLE I

Direction of vibration of incident light along	Orientation of the optic axis along	Relative intensities of components of Raman lines					
		155		282		1084	
		OX	OZ	OX	OZ	OX	OZ
OZ	OX	40	0	100	0	0	70
OY	,,	40	0	100	0	0	100
OZ	OY	0	0	0	0	60	100
OY	,,	40	20	100	50	0	0
OZ	OZ	40	0	100	0	0	30
OY	,,	30	40	80	100	0	0

A very satisfactory agreement between the figures given in Table I and the results of Nedungadi is noticed. Amongst the important conclusions drawn by Nedungadi are the following which are also found to hold good in calcite. Both the low frequency lines disappear while the line at 1084 due to the total symmetric oscillation comes out strongly in the spectrum of the light scattered along the optic axis when the incident light vector lies in the plane of the carbonate ion (3rd row of Table I). On the other hand, the same low frequency lines come out strongly while the line at 1084 disappears in the spectrum of the light scattered along the optic axis when the incident light vector is perpendicular to the plane of the carbonate ion

(4th row of Table I). Besides such a reversal of intensities, it may be noted that the low frequency lines exhibit polarisation features which may be regarded as reciprocal in character to those exhibited by the total symmetric oscillation. The figures given in Table I clearly support these conclusions.

The author has not been able to record the other weaker lines due to internal oscillations in the case of calcite but a few remarks about these will not be out of place here. A detailed analysis of the normal oscillations[2] shows that these are degenerate and come under the same category as the low frequency lines. Their behaviour should accordingly be akin to the low frequency lines rather than to the total symmetric oscillation. Contrary to this expectation, Nedungadi concludes that all the internal oscillations behave in a like manner. His pictures however show that while this is true in the matter of polarisation, it is not so if we consider the aggregate intensities. It is clear from Figs. 3 *a* and *c* of his paper, which are intended to show this effect, that only the total symmetric oscillation becomes weak whereas the degenerate oscillation at 1385 as well as the low frequency lines remain quite intense. Figs. 6 *c* and *d* of Nedungadi taken together also show the similarity between the low frequency lines and the degenerate internal oscillations in the matter of aggregate intensities. A detailed account of the results along with a fuller discussion of the same will appear elsewhere in due course.

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[1] *Proc. Ind. Acad. Sci.*, 1939, **10**, 197.
[2] *Ibid.*, 1939, **9**, 224.

Interaction of Atomic Energy Levels

The mutual influence of different elements on their spectra due to mixture has not yet been studied in a systematic way, although there are a large number of papers dealing with the influence of the rare gases on the spectra of several elements. The effect of introducing gases like hydrogen and nitrogen has also been studied to a certain extent. With the object of securing more extensive data regarding the changes produced in the spectra of elements by mixing them, we have first of all studied the effect of mixing zinc and mercury. The discharge from a 3 KVA, 2000 volt transformer was passed through a Pyrex tube containing mercury and zinc in two side limbs provided with tungsten electrodes and kept continuously evacuated by a Hyvac pump. The tube had a quartz window through which the discharge could be viewed end on. The light from the discharge was focussed on the slit of a concave grating of 10-foot focus in a Rowland mounting by means of quartz lenses. To distinguish between first and second order lines a thin glass plate was fixed across half the slit so that in the spectrogram the second order lines were shorter than the first order ones. Zinc of analytical reagent class was used as also another variety from De Haen which showed a slightly larger quantity of mercury as an impurity. Spectrograms were obtained with pure zinc and with a mixture of zinc and mercury so as to exhibit the same intensity in the case of the visible zinc triplet, and conclusions were based on a comparison of the intensities of other lines relative to these in the two spectrograms. A vacuum arc was produced in the same tube by connecting the two side limbs to 110 volts D.C. and having a third electrode which served to start the arc in the zinc vapour by means of a small induction coil connected to it and to one of the other electrodes. The spectrum of the arc was found to be almost identical with that of the discharge, except that the arc was much brighter. The spectra were photographed on Ilford hypersensitive panchromatic films and second order lines in the case of the discharge appeared with sufficient intensity after exposures of about an hour. A discharge through $HgCl_2$ vapour had previously been studied and the relative intensities of the mercury lines in the mixture were compared with the relative

intensities of the same lines in the $HgCl_2$ film. The following are the main results obtained:

1. The lines 3072 ($4\ ^3P_2 - 6\ ^3S_1$), 3036 ($4\ ^3P_1 - 6\ ^3S_1$) and 3018 ($4\ ^3P_0 - 6\ ^3S_1$) of zinc were very weak in both the arc and the discharge as compared with the resonance line

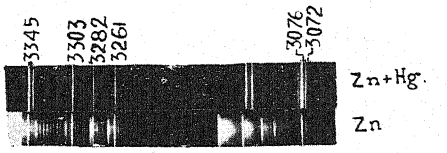

FIG. 1

3076 ($4\ ^1S_0 - 4\ ^3P_1$), whereas in the spectrogram given in Fowler's Report 3072 is brighter than 3076. This was true both in pure zinc and in the mixture. The intensities of these lines given by Hetzler, Boreman and Burns[1] show that this peculiarity is characteristic of the vacuum arc itself.

2. In the discharge through pure zinc 3076 was weaker than 3345 ($4\ ^3P_2 - 4\ ^3D_{2,3}$) and 3302 ($4\ ^3P_1 - 4\ ^3D_2$), but in the mixture it was stronger. Hetzler, Boreman and Burns who used an arc in vacuum between brass electrodes find 3076 weaker than 3345 and 3302. We find that 3076 brightens considerably with even small amounts of mercury, and possibly also with other impurities.

3. The zinc lines 2464 ($4\ ^3P_2 - 8\ ^3D_3$), 2480 ($4\ ^3P_0 - 7\ ^3D_1$), 2492 ($4\ ^3P_1 - 7\ ^3D_2$) and 2516 ($4\ ^3P_2 - 7\ ^3D_3$) decrease considerably in intensity in the mixture as compared with pure zinc. 2609 ($4\ ^3P_2 - 6\ ^3D_3$) and 2671 ($4\ ^3P_0 - 7\ ^3S_1$) also decrease in brightness to about a similar extent. A smaller decrease in intensity occurs in the case of 2568 ($4\ ^3P_2 - 8\ ^3S_1$), 2570 ($4\ ^3P_0 - 6\ ^3D_1$), 2583 ($4\ ^3P_1 - 6\ ^3D_2$), 2684 ($4\ ^3P_1 - 7\ ^3S_1$) and 2712 ($4\ ^3P_2 - 7\ ^3S_1$). 5182 ($4\ ^1P_1 - 6\ ^1S_0$) remains unaffected.

4. The mercury lines 2753 ($6\ ^3P_0 - 8\ ^3S_1$), 2894 ($6\ ^3P_1 - 8\ ^3S_1$) and 3342 ($6\ ^3P_2 - 8\ ^3S_1$) showed a definite increase in intensity as compared with the same lines produced by the discharge through $HgCl_2$, while 3663 ($6\ ^3P_2 - 6\ ^1D_2$ and $6\ ^3P_2 - 6\ ^3D_1$), 3655 ($6\ ^3P_2 - 6\ ^3D_2$) and 3650 ($6\ ^3P_2 - 6\ ^3D_3$) showed only a slight increase. 3132 ($6\ ^3P_1 - 6\ ^1D_2$ and $6\ ^3P_1 - 6\ ^3D_1$) and 3126 ($6\ ^3P_1 - 6\ ^3D_2$) seemed to be unaffected.

5. The only spark line of zinc, 2558 ($4\ ^2P_{3/2} - 5\ ^2S_{1/2}$), and of mercury, 3984 ($5d^{10}6s^2\ ^2D_{3/2} - 5d^{10}6p\ ^2P^0_{3/2}$) occurring in the discharge used, disappeared in the mixture.

The brightening of 3076 must be due to collisions of the second kind between mercury atoms in the $6\ ^3P_1$ state (energy 4·86 volts) and normal zinc atoms. According to Larché[2] the optimum excitation potential of 3076 is 4·9 volts. This explanation is also in accord with the fact that the spectrum of zinc given by Lord Rayleigh,[3] who distilled zinc vapour into a cadmium arc, shows 3076 weaker than 3072 itself. The energy of the $5\ ^3P_1$ state in cadmium is only 3·78 volts.

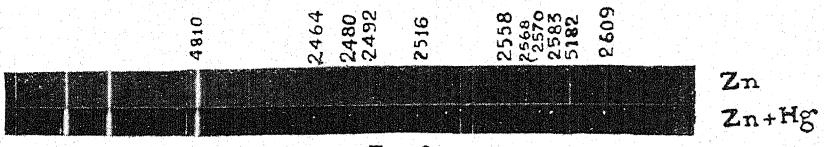

FIG. 2

The weakening of 2464, 2480, 2492 and 2516 must be due to the impoverishment of the $8\ ^3D$ and $7\ ^3D$ zinc atoms (energy 9·06 and 8·96 volts by interaction with mercury atoms in the $8\ ^3S_1$ state (energy 9·12 volts) since 2753, 2894 and 3342 of mercury show

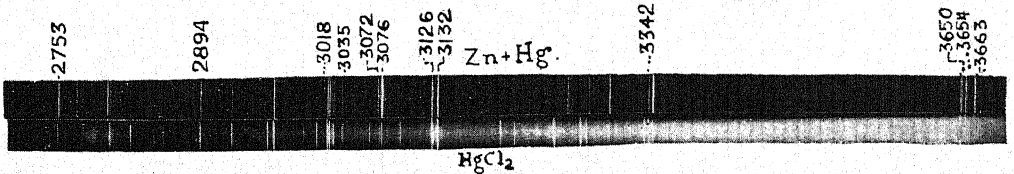

FIG. 3

an increase in intensity. The fact that the 6 ^{3}D states of mercury (energy 8·80 volts) do not show any marked enrichment at the expense of the 6 ^{3}D states of zinc (energy 8·79 volts) shows that such an interaction does not depend merely on the nearness of their energies. We may surmise that electrons first take up energy from the 8 ^{3}D and 7 ^{3}D zinc atoms and then enrich the 8 $^3S_1$ mercury states.

The work is proceeding; further details will be published elsewhere.

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1 *Phys. Rev.*, 1935, **48**, 656.
2 *Zeit. f. Phys.*, 1931, **67**, 440.
3 *Proc. Roy. Soc.*, (A), 1926, **112**, 14.

Sound Velocity and Inter-Molecular Forces

IN recent years the velocity of sound has been determined with precision in a large number of liquids using ultrasonic waves.[1] The velocity of sound in a liquid is determined by the molecular arrangement in the liquids and the nature of the inter-molecular forces. It is found that in general the velocity of sound decreases with rise in temperature. A study of these shows that the ratio of the relative temperature coefficient of sound velocity to the coefficient of molar volume expansion is constant for a number of non-associated liquids. The mean value for the constant is found to be $-3{\cdot}03$. Thus

$$\frac{\frac{1}{v}\frac{dv}{dt}}{\frac{1}{V}\frac{dV}{dt}} = -3{\cdot}03,$$

where v is the velocity of sound in the liquid at temperature t and V the molar volume of the liquid. On integrating the above expression

$$vV^{3{\cdot}03} = \text{constant}$$
$$v^{0{\cdot}33}V = \text{constant}.$$

Table I gives the values of the velocity of sound and density at various temperatures. The molecular volume V multiplied by $v^{0.33}$ is found to be a constant over the entire temperature range for which values are available. In Table I values for only two liquids are given but the relation holds good for a number of other liquids like octane, heptane, chloroform and carbon tetrachloride.

Table II gives the values of the constant $R = v^{0.33}\,V$ for a number of liquids and also the molecular critical volume V_c. It is found that the ratio of the constant R to the molecular critical volume V_c of a given compound has an almost constant value of 3·53 for all substances.

Since the molecular volume is proportional to the cube of the inter-molecular distance it follows from $R = v^{0.33}\,V$ that the velocity of sound in a liquid varies inversely as the ninth

TABLE I

Benzene				*Toluene*			
Temperature	Velocity (m./s)	Density	$v^{0.33}V = R$	Temperature	Velocity (m./s)	Density	$v^{0.33}V = R$
10	1375	·8896	951	0	1414	·8848	1141
20	1324	·8790	951·5	10	1370·5	·8752	1140
30	1278	·8684	952·1	20	1327·5	·8657	1140
40	1231	·8576	953	30	1284·5	·8563	1141
50	1184	·8467	951·9	40	1242·0	·8470	1141
..	..	..	..	50	1199	·8378	1140

TABLE II

Substances	Value of R	Molecular critical volume V_c	$\frac{R}{V_c}$
Benzene	951·9	256·1	3·71
Octane	1681	487·6	3·44
Carbon tetrachloride..	924·1	276·1	3·35
Heptane	1499	427·1	3·51
Toluene	1140·5	315·4	3·61
Chlorobenzene ..	1179	307·8	3·51
Propyl acetate ..	1191	345·3	3·45
Ethyl propionate ..	1192	344·3	3·46

power of the distance between the molecules. Although the nature of the inter-molecular forces in a liquid are complex, it is convenient to assume the inter-molecular potential energy between two molecules to be given by

$$E = \frac{\lambda}{r^m} - \frac{\mu}{r^n}$$

where $\frac{\lambda}{r^m}$ is the term arising due to repulsive forces which is very small and $\frac{\mu}{r^n}$ is the term arising due to Vander-Waals attractive forces. Various estimates have been made of the values of m and n. Edser[2] finds a value for $n = 8$, while Wheeler[3] gives a value for $n = 10$. It is interesting to find that the present value of $n = 9$ found from a study of the sound velocities is therefore in conformity with the previous values. It is also found that in any homologous series the constant R increases with the number of CH_2 groups, *i.e.*, by equal increments. The relation between the constant R and chemical constitution and other details will be published elsewhere.

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November 4, 1939.

[1] Bergman, *Ultra Schall*, 1937.
[2] Edser, *Fourth Report on Progress of Colloid Chemistry*, 1922.
[3] Wheeler, *Ind. Jour. Phys.*, 1933, **8**, 523.

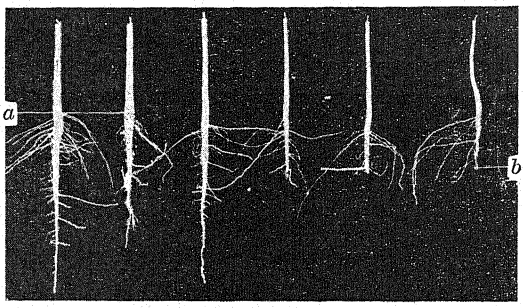
The Root Knot Disease of Cotton

NEMATODE (eelworms) had been reported by Milne (1913) and Likhite (1934) on roots of cotton plants affected by the root rot disease. Usually they are found in the decaying shreds of root bark at an advanced stage of the disease. During the investigation of the root rot disease of cotton in the Punjab, nematodes were observed even on roots of apparently healthy plants. Recently the examination of roots of cotton plants of *Gossypium indicum* var. *Mollisoni* in some fields not affected by the root rot disease was undertaken. In some cases, the tap-root was found to bear swollen gall-like structures. The swellings were formed also on lateral root-lets. The examination of the interior of these knots showed presence of many slender eelworms. The galls have been found on the side of tap-root and also on its tip. In the latter case further growth of the tap-root is stopped. A similar disease is present almost in every State in the Cotton Belt of the United States of America, and is caused by the nematode *Heterodera marioni*.

The root knot disease has not been reported from any part of India so far. The incidence of this disease varies in different fields. It has been observed at Lyallpur, Sargodha and Khanewal. A survey of the cotton fields is required to determine the occurrence and incidence of the disease. The diseased material has been sent to Dr. Shirlaw and Dr. Thapar for identification of the nematodes.

Most of the plants affected by the root knot disease appear to be almost normal. But in the case of heavy infestation the colour of the leaves of the plants turns pale and the plants remain stunted.

In addition to cotton, eelworms have been found in lesions on the roots of various crops, *i.e.*, Mash (*Phaseolus radiatus*, Linn.), Guara (*Cymopsis psoralioides*), Groundnut (*Arachis hypogea*) and on weeds, *e.g.*, *Trinanthema* and *Heliotropium supinum*.



Roots bearing (*a*) nematode lesions on sides — Roots with (*b*) nematode knots at the tips

Fig. 1 shows the root systems of healthy and root knot affected plants.

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October 31, 1939.

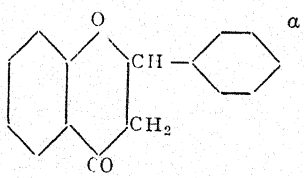
Milne, D., "Report of the Operations of the Department of Agriculture, Punjab," 1913.

Likhite, V. N., and Kulkarni, V. G., *Curr. Sci.*, 1934, 3, 252.

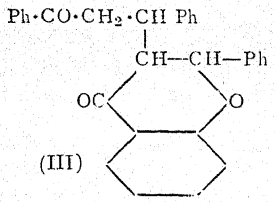
Condensation of Chalkones with Flavanones

A STUDY has been made of the condensation of chalkones with flavanones and it has been found that phenyl styryl ketone (I) reacts with flavanone (II) in presence of 30% NaOH, to form (III). A number of chalkones and flavanones have thus been condensed, in presence of alkali or sodamide or pulverisodium (in ether or toluene), the last two being particularly effective.

Ph·CO·CH=CO·Ph
(I)



(II)



(III)

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State Laboratory, Dublin,
September 4, 1939.

Fossil Algæ in the Eocene Beds of the Salt Range

THE object of this note is to report the discovery of fossil algæ in some of the limestones from the Eocene of the Salt Range (Fig. 1). A general examination of this material shows that

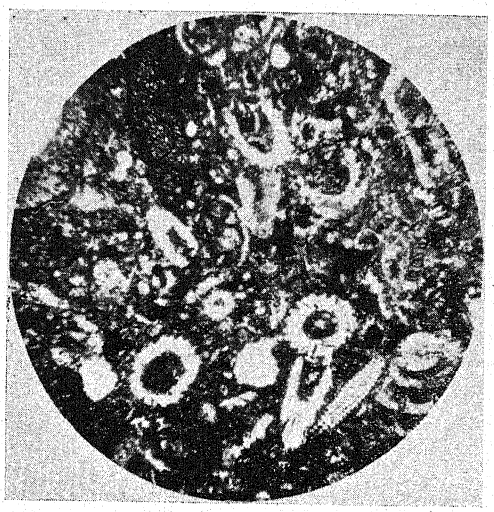

FIG. 1
Section of Khairabad limestone showing fossil algæ. × 17

this algal flora is quite rich and varied—the Dasycladaceæ being the most prominent group. Side by side with genera like *Dissocladella*, *Acicularia* and *Neomeris*, which are known to commonly occur in rocks of Eocene age, it is most interesting to find in these rocks forms like *Oligoporella* and *Diplopora* which are elsewhere unknown in beds younger than the Trias. A detailed study, which is under progress, of

this rich algal flora promises to be of great interest, both from the stratigraphical and the palæobotanical points of view.

We are deeply indebted to the authorities of the Burmah Oil Company Ltd., for letting us have samples of these limestones for study and for permitting us to publish these results.

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November 9, 1939.

Effect of Anti-oxidants on the Stability of Vitamin-A in Ghee exposed to Sunlight

THE action of light, particularly ultra-violet rays, on butterfat (ghee) has been studied by several workers. Banerjee and Dastur[1] have shown that the destruction of vitamin-A in ghee when exposed to sunlight is considerable, especially when ghee is exposed in thin layers to direct sunlight. They have also shown that when the ultraviolet and heat rays are cut off the extent of vitamin-A destruction is somewhat reduced. This, and the researches of various workers on pro- and anti-oxidant properties of various substances (Olcott,[2] Mattill,[3] Lea,[4] and others), led us to study the effect of some of the anti-oxidants on the vitamin-A potency of ghee. Hydroquinone, sodium citrate and sodium tartrate were found to retard the rate of auto-oxidation in ghee, hydroquinone being the most effective anti-oxidant. It was considered probable that these anti-oxidants might also serve to minimise the detrimental effect of light on the vitamin potency of ghee.

Accordingly, an experiment was conducted under controlled conditions on the same lines as those adopted by Banerjee and Dastur (*loc. cit.*). All exposures were performed between 11 a.m. and 1 p.m. so as to allow vertical rays of the sun to fall directly on the materials. The layers of ghee were of 1–2 mm. thickness. Hydroquinone was added in amounts equal to 0·03 per cent. of the ghee (the quantity specified by the League of Nations' Health Organisation). Saturated solutions of sodium citrate and sodium tartrate (to which no objection can be raised) were added in quantities to make up 0·2 per cent. in the ghee. Vitamin-A determinations were made colorimetrically using the B.D.H. Lovibond tintometer and expressed as Blue Values in Lovibond Units per gram of ghee.

Cow and Buffalo ghees (vitamin-A content 17·4 and 15·4 B.V. respectively) were exposed to direct sunlight for 10 minutes with and without the anti-oxidants and their vitamin contents determined. The vitamin (estimated on 0·2 ml. fraction of unsaponifiable matter) was found to be absent in all the samples.

The experiment was repeated with the time of exposure shortened to 2 minutes. In this experiment also the almost total destruction of the vitamin was observed. Even with 1 ml. fraction of unsaponifiable extract, only a trace of blue colour was observed.

The results indicate that the presence of any of these anti-oxidants does not retard or minimise the destructive action of light on the vitamin content of ghee. The identical results obtained with Cow and Buffalo ghees when exposed to sunlight indicate that the natural colouring matter, *carotene*, which is present in larger amounts in Cow ghee, appears to have no protective action against the destructive effect of light on the vitamin-A.

It is, therefore, concluded that in order to preserve the nutritive growth-promoting factor of ghee, great care should be taken to avoid unnecessary exposure to sunlight.

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November 9, 1939.

[1] Banerjee and Dastur, *Agric. & Livestock in India*, 1936, **6**, 433.
[2] Olcott, *J. Amer. Chem. Soc.*, 1934, **56**, 2492.
[3] Mattill, *J. Biol. Chem.*, 1931, **90**, 141.
[4] Lea, *Rept. Food Investigation Board* (Brit.), 1934, p. 38.

REVIEWS

Fabre and Mathematics and Other Essays. By L. G. Simons. (*Scripta Mathematica*, New York), 1939. Pp. 101. Price $1·00.

This small volume by Prof. Simons consists of a collection of four essays which are of a biographical and historical interest. The first two essays give an account of the keen interest in mathematics shown by the eminent entomologist, Henri Fabre, and by the great German savant, Alexander von Humboldt. The author's aim in presenting this account is to record the appreciation of mathematics by men in other fields. Prof. Simons has produced ample evidence to show the influence of an earlier mathematical training on Fabre's entomological work, and the extent to which he employed the mathematical concepts for the explanation of phenomena in the insect world. This has been acknowledged enthusiastically by the scientist himself.

Prof. Simons shows clearly in his second essay that Humboldt had penetrated far enough into the field of Mathematics to express an admiration for its methods. A detailed account is given of Humboldt's correspondence, extended over forty-eight years with C. F. Gauss. He describes also Humboldt's researches into the history of mathematical numeration and notation of primitive tribes and early peoples, which were made by Humboldt in his extensive travels. An analysis is also given of Humboldt's lifework, "Cosmos", which reveals the extent of Humboldt's knowledge of the history of mathematics, and his profound appreciation of the part played by mathematics in all the life of the world.

The third essay deals with the influence of French mathematicians upon the teaching of mathematics in American colleges. It is remarked that when the *American Academy of Arts and Sciences* was founded in 1780, its founders placed on record the statement that it was their intention "To give it the air of France rather than that of England and to follow the *Royal Academy* rather than the *Royal Society*". *The Normal School* and the *United States Military Academy* were founded on the model of the *Ecole Normale* and the *Ecole Polytechnique*. The works and text-books of Lagrange, Laplace, Legendre, Monge, Bourdon, Biot, Lacroix and others were translated and extensively used upto the 19th century. France can thus justly lay claim to the accomplishment of a revolution in all branches of mathematics in America as well as in other countries.

In his fourth essay Prof. Simons has given the story of Geometry as studied in several American colleges, such as those at Harvard, Yale, Columbia and Pennsylvania. He records Thomas Brattle's evidence to show that Euclid was no part of the course at Harvard at the end of 17th century. He records further that among the mathematical problems required by the Department of Mathematics for graduation towards the close of the 18th century, not one demonstration of a geometrical theorem is found, although a knowledge of geometrical truths is required for the solution of many of the problems set. He gives the record of a public examination conducted in 1786, "in which each student was required to draw a number out of a box and to demonstrate without further assistance the problem or theorem in Euclid to which it referred".

The book can heartily be recommended to the mathematician and the layman alike. It would exercise a salutary effect on the appreciation of mathematics as a part of the educational discipline for all students through the secondary school grade—a fact to be emphasised in an age when there is so much misdirected clamour for a so-called realistic and vocational education.

There is a printing mistake on page 73, last but one line, where Greenwood's first year of Professorship at Harvard is wrongly given as 1772 instead of 1728.

M. R. SIDDIQI.

Rayons Cosmiques. III. By J. Clay, P. M. S. Blackett and G. Lemaitre. (Herman et Cie, 6 Rue de la Sorbonne, Paris). Papers read in October 1937 at The Congrés du Palais de la Découverte, Paris. Pp. 37. Price 10 *fr.*

In the first section of this report J. Clay of the Natureskundig Laboratorium, Amsterdam, discusses the very complicated phenomena of "penetration and degradation

of cosmic rays in matter". After a very brief summary of current ideas on the subject the writer describes and gives the results of a series of ingenious experiments designed to throw light on the complicated processes which cause the discharge of ionization chambers. It is shown that the "radiation complex" which ionizes the gas in a chamber, consists of hard cosmic rays, soft cosmic rays, photons produced in the gas and in the walls of the chamber and by "artificial radio-activity" induced chiefly in the walls of the chamber by cosmic rays. Of course, many of these rays, both hard and soft, are secondaries which in turn produce tertiaries and so on until the original energy is dissipated as heat chiefly by a process of ionization in absorbing matter.

In the second part of the report P. M. S. Blackett of Cambridge discusses the behaviour of cosmic rays in the atmosphere and especially the nature of the hard component which constitutes about 80% of the cosmic radiation found at sea level. This section presents clearly the background for the subsequent discovery of the mesotron (heavy electron), and helps one to realize how complex and difficult is the still unsolved problem of the hard component of cosmic radiation. The section ends with comments by Pierre Auger and by Homi J. Bhabha, who have made especially important contributions to cosmic ray theory.

The third section is a discussion of the behaviour of cosmic rays in the earth's magnetic field and of their intensity variations. The subject is introduced by G. Lemaitre of Louvain, who gives a very brief resume of current ideas. E. M. Bruins of Amsterdam presents results of extensive measurements of cosmic ray intensities at various latitudes and longitudes and discusses intensity anomalies due to the lack of uniformity of the earth's magnetic field.

J. Barnothy and Mlle. Forro present evidence obtained by means of Geiger-Muller counters during a period of three years indicating a periodic variation of cosmic ray intensity with siderial time. The amplitude of the variation reported by these workers is much larger than that predicted by Compton and Getting in 1936. In explanation of measurements made with counters in deep mines they suggest that cosmic ray showers found at great depths under water or rock are caused by neutrinos.

It is interesting to note that the nature of the very penetrating portion of cosmic rays is still a mystery in spite of much recent work. J. M. BENADE.

Réunion Internationale de Physique-Chimie-Biologie. Congrès du Palais de la Découverte, Paris, October 1937. II Physique Nucléaire. (*Actualités Scientifiques et Industrielles* No. 719) (Hermann et Cie, Paris), 1938. Pp. 54. Price 15 *fr.*

This is the second part of the Report of the discussions held in connection with the International Congress at the Palace of Discovery in 1937. It deals with Nuclear Physics and contains papers by Bohr (introductory), Scherrer (the reaction $D + D = {}^3He + n$), Cockcroft (transmutation of elements), and Bothe (spectroscopy of nuclei). Short summaries of remarks made by others who took part in the discussion are also included. The brochure gives a succinct account of the new point of view introduced by Bohr in nuclear theory, and the most important experimental methods and the chief results of nuclear research. Seeing that the contributors are the leading authorities in the several lines of enquiry here brought before the ken of the reader, it would be superfluous to add that a just and illuminating statement of the present position of theory and experiment in the field of nuclear physics is here presented. T. S. S.

Atomic Structure. By Leonard B. Loeb. (John Wiley & Sons, Inc., U.S.A.; Chapman & Hall, Ltd., London), 1938. Pp. xvi + 446. Price 22*sh.* 6*d.*

This is an introductory text-book on Atomic Structure. Written in the clear style characteristic of the author it embodies the fundamentals of atomic physics. The order of presentation follows the historical development of the subject. Both the lecturer in atomic physics and the student must bear in mind the following statement of the author in the Introduction. "Physicists live in a mechanical world and their physical thinking is in terms of their experience and of the Newtonian physics which they first learned... In fact with the abstract nature of wave mechanics it would be impossible to introduce students to the subject by such means". We heartily endorse the view expressed in these sentences and the lecturer introducing the subject of atomic physics to

his students must remember the fact that wave mechanics can be grasped by the beginner only after he has had a grounding in the subject starting from Newtonian mechanics.

The text is divided into four parts and contains twenty-one chapters in all. The first chapter is a comprehensive summary of the growth on classical lines of our knowledge of the electron, and contains concise but clear accounts of the experimental investigations on e/m, e and m of the electron together with the relativity correction for its mass and other related topics. Chapter two treats of Positive Rays, Aston's mass spectrograph and Radio-activity. Chapter three is concerned with X-Rays. The rest of Part I treats of the atomic nucleus including the Gamow Nuclear Model. Part II treats of the development of spectral theory based on Rutherford's nuclear atom and beginning with Bohr's explanation of the atomic spectrum of hydrogen. Part III deals with the Electrical Properties of Atoms and Molecules and embodies a number of related subjects among others, ionisation potentials, energy level diagrams, photoelectric phenomena, atomic and molecular structure and band spectra. In Part IV are treated the kinetic theory of gases, the electron theory of metals and the wave mechanical concept of the metallic state. Throughout the author has treated the various matters connected with atomic structure with remarkable clearness and accuracy. The beginner in this subject cannot get a more entertaining and instructive book dealing with the fascinating subject of atomic physics. One who has mastered this book will be in a position to read with benefit more advanced books on atomic theory. We have no hesitation in recommending the book to first and second year students of Indian Universities taking both Pass and Honours courses. B. V.

Theory and Design of Valve Oscillators for Radio and Other Frequencies. By H. A. Thomas. (Chapman & Hall, Ltd., London), 1939. Pp. 292, figs. 103. Price 18*sh.*

This book forms volume seven of 'A Series of Monographs on Electrical Engineering' under the editorship of Mr. H. P. Young. Prof. Appleton has aptly remarked in his Foreword to this book: 'Among the ever-increasing number of applications of thermionic valve, there can surely be none more striking or of greater consequence than its use as a generator of sustained electrical oscillations.' The present volume from the pen of Dr. Thomas, whose pioneering work in this field has won him world-wide recognition, is very welcome.

As the title suggests, the treatment is confined to the generation of self-oscillations by a thermionic valve and excludes crystal controlled oscillators, etc. The author clearly points out in his Preface that since a vast amount of easily available literature on quartz crystals exists, such material has been excluded from his treatment.

The book is meant for the 'advanced student and technician' and assumes a good knowledge of A.C. theory and mathematics, including differential equations.

The field of use of the self-oscillator is very large indeed and Dr. Thomas has not spared to give a thorough treatment. The book is divided into eleven chapters. After the first few chapters on the fundamental principles of self-oscillations and the conditions for maintaining them, a critical survey of the various factors affecting the change in frequency are considered; finally, the different methods of frequency stabilisation are presented.

The chief problems in the design of any oscillator are:—

(1) the magnitude and constancy of amplitude;
(2) the harmonics content in the oscillatory current;
(3) the efficiency of conversion;
(4) the value and stability of the frequency of oscillation.

These the author has discussed in great detail. A clear graphical analysis of the effects resulting from a variation of any one of the circuit parameters is given. The qualitative treatment gives a clear insight into and prepares the ground for the study of frequency stability in later chapters.

The range of oscillators described is indeed wide: starting from the simple dynatron, various retroactive types are deduced, by omitting one or more circuit elements. Also relaxation oscillations (including those of Van der Pol's type) have been considered. The analytical method, due to Prof. Moullin, for the rough estimation of the harmonic content is explained, followed by an example.

Although the book is well written on the whole, it is a little disappointing to note that

some important types of oscillators, *e.g.*, the push-pull, magnetron and heterodyne types, have not been dealt with in the text.

Chapters 6 and 7 dealing with the effects of temperature on 'L' and 'C', contain much valuable information drawn upon the author's personal researches. The last three chapters of the book are extremely practical and useful.

The extensive bibliography at the end of the book containing 83 references should prove invaluable. The general get-up of the book is good and the price reasonable.

Finally, the reviewer considers he cannot do better than quote Prof. Appleton's words in the latter's Preface to this book: To any one likely to employ a valve-oscillator for any purpose whatever, this can be unhesitatingly recommended as a friendly and trustworthy guide. V. V. L. R.

A Practical Manual of Chemical Engineering. By Harold Tongue. (Chapman & Hall, Ltd., London), 1939. Pp. xv + 560. Price 36*sh.*

Like other subjects in the hinterland between two or more sciences, Chemical Engineering is so wide in its scope and requires for its study a basis of so many sciences that any one who sets out to write a book on Chemical Engineering would be faced initially with difficulties regarding the limits of his task. While a knowledge of Chemistry, Physics, Mathematics and the several branches of engineering are necessary for the chemical engineer, and their immediate application to large-scale chemical processes must find a place in a text-book on the subject, an attempt to be really comprehensive in these directions would mean the compilation of a very large treatise. Restriction to the unit operations of which the chemical engineer has perforce to have detailed knowledge is, therefore, usual. Chemical Engineering treatises now available are mostly of American origin and are therefore concerned with American practice; a book representing British practice and describing British chemical plant is of special interest.

The book under review consists of two sections. The first six chapters deal with materials of construction and design of pressure plant, the latter being also the subject of a separate and well-known volume by the same author. The first section is packed with data of great practical value to the chemical engineering student and to the professional chemical engineer. The second half of the book, consisting of ten chapters, deals with some of the important unit operations. The chapters on heat transfer, evaporation, steam plant, drying, and distillation deserve special commendation for clarity and thoroughness.

The title is not altogether appropriate, as it might lead one to expect a laboratory manual with experimental suggestions and details, which may be used by the teacher for the conduct of practical classes. Such a practical handbook incidentally would be a very welcome reinforcement to the text-book resources of the teacher in Chemical Engineering.

The relative importance of the various branches of a subject must remain a matter of opinion, but the attention accorded to some of the topics in the present book is obviously disproportionate. "Filtration" has been confined to a description of filters, experimental methods, equations and their application in practice not finding a place. Super-centrifuges are barely mentioned. "Transportation of fluids" has received inadequate treatment, while other unit operations, such as size separation and crystallisation, have been omitted. Chapters I and VI might have been considerably abbreviated, and provision made for filling up the gaps to which reference has been made. The copious diagrams and tables are very valuable, but the illustrations in full-page plates are of doubtful utility in comparison with the cost.

Among the corrections of printing errors that may be made in a later edition are the replacement of "u" by "μ" (p. 329), "9" by "11" in the equation referred to in the second paragraph of p. 346, "separation" by "expression" in the last line but one on p. 435, and "vapour" by "liquid" in line 4 on p. 441. In the diagram on p. 432, the upper edge of the vapour nozzle should be higher than the top edge of the downtake pipe to the plate below. The illustration referred to in paragraph 4, p. 260, is missing. In equation (15), p. 344, "¼" should be taken outside brackets and applied to the whole fraction by which the figure 0·725 is multiplied. These defects and errors are, however, of a minor character. This contribution to the literature of Chemical Engineering is an extremely useful addition to a technological library. K. V. & J. G. K.

An Introduction to Genetics. By A. H. Sturtevant and G. W. Beadle. (W. B. Saunders Company, Philadelphia), 1939. Pp. 391, figs. 126. Price $3·25.

The authors of this text-book have both spent their lives in pioneer research on the frontiers of genetical exploration. The senior author was one of Prof. T. H. Morgan's original band of graduate students at Columbia in 1910, when Drosophila investigations were first begun. The junior author has already achieved an enviable international reputation. It is doubtful whether another pair of men could be found better equipped to expound the science of genetics or to discriminate what is of most value for an introductory course. In this book they have followed a particularly attractive and logical method of presentation. The cytological mechanisms and the genetical ratios are presented together, the former elucidating the latter.

That genetics is a science of ratios is emphasised and at the start the reason for the sex-ratio of 1:1 is demonstrated. From this it is logical to pass on to sex-linkage-autosomal inheritance and classical Mendelian ratios. For classes this arrangement permits an immediate application of the textual material in breeding studies with Drosophila. The phenomena of linkage and crossing-over are approached from results of actual experiments with two, and then three, gene pairs involved. This is clarified by excellent diagrams of meiosis in which four-strand crossing-over (chiasma formation in split chromosomes) is shown. Cross-over values lead to chromosome map-making, which is illustrated by *Drosophila melanogaster* and *Zea mays*. The rôle that abnormalities, such as attached X-chromosomes in Drosophila also translocations and inversions, have played in elucidating genetical principles is explained. The value of the now famous giant salivary glands for identifying chromosomal regions and for direct observation of inversions, duplications and deletions of segments is demonstrated by diagrams and micro-photographs. Clear explanations are given of other genetical phenomena which are frequently mystifying to the beginner, including: blanaced lethals, multiple-cross-overs, ring formation and semi-sterility produced by reciprocal translocations, multiple alleles, position effects, non-disjunction and mutations.

In the last third of the book the authors deal in a masterly manner with matters of wide implication with respect to evolution. The most important of these are: the genetic basis of sex, selection in relation to continuous variation, practical breeding phenomena, polyploidy, the genic relationships in heterogeneous populations and between species. Two chapters of particular interest, which deal with the very latest research results, are those on "Extrachromosomal Inheritance and Maternal Influences" and "Genes and Phenotypes", in which problems of development are considered.

The authors have expressly refrained from including an extensive bibliography, but adequate references are provided in every chapter. Instructive sets of genetical problems are also given with each chapter. The book concludes with a brief, just historical summary.

The method used by the Drosophila school of designating wild type genes by a plus sign and the recessive alleles by the small initial letter of the name of the gene is followed. When discussing the hypotheses for blood group inheritance in man, the genes are denoted in the more usual manner, *i.e.*, 'A' for dominant and '*a*' for recessive. A foot-note on the latter method of writing allelomorphic pairs would be helpful to many readers. Those who have had no experience with Drosophila may well feel doubts as to human ability to distinguish between some of the eye colours shown in Plate I. This is purely a matter of training and can be done unfailingly by the "Drosophila people", even as a shepherd easily recognises each of his sheep.

This book can be confidently recommended, not only as a beginner's test, but to mature students whose genetical knowledge is rudimentary, or obsolete, or otherwise in need of refurbishing.

EILEEN W. ERLANSON MACFARLANE.

Bacteria in Relation to Milk Supply. By C. H. Chalmers. (Edward Arnold & Co., London), 1939. II Edition. Pp. 201. Price 6*sh.*

The fact that the second edition has been issued hardly four years after the publication of the first, shows the popularity with which Chalmer's book has been received. The book is divided into two parts loosely termed "Principles" and "Practical Applications" which are treated in the reverse order as in the first edition. The further sub-

division of the parts into chapters also has remained the same as in the first edition. The author has rewritten some portions in the first part on "Practical Applications" and has revised the sections on the methylene blue reduction test and the phosphatase test and also enlarged the section on sampling and thus brought the information up to date. Minute details are given on counting of bacteria, on milk smears, calculation of magnification on the microscope and measurement of bacteria. The nature and causes of abnormal conditions of milk such as bitterness, oiliness, sliminess, fishiness, caramel, phenol, alcohol and cardboard flavours of milk have also been properly dealt with. Methods have been indicated for testing additions of colouring matter and preservatives of milk. Illustrations of the different forms of bacteria and detailed descriptions of bacteria occurring in milk will prove useful to the students using this book. Methods for the detection of indol, phenol, acetylmethyl carbinol, etc., have been included and given in some detail.

Although the author has given references to easily accessible literature, especially about the new matter included in this edition, he has not mentioned the original sources of the material included in the book. This would have helped the readers a great deal in finding out and examining the original literature on dairy bacteriology whenever they felt inclined to do so, because although meant chiefly for the dairy bacteriologist engaged in testing milk for the milk industry, this book is likely to be used by students and teachers in dairy bacteriology; and to these latter class of persons, citations of original literature on the whole subject-matter of dairy bacteriology would have proved very useful indeed. N. V. J.

Qualitative Organic Chemistry. By Neil Campbell. (Macmillan & Co., Ltd., London), 1939. Pp. x + 213. Price 8*sh.* 6*d.*

The book is mainly divided into two parts.

Part A deals with the purification of organic compounds and with a scheme for their identification, which is essentially based on chemical properties. The theoretical basis underlying the practical methods has been emphasised by inclusion of a chapter on properties and reactions of the various types of organic compounds. The author has rightly emphasised the preparation of suitable derivatives as a very essential part of organic identification. The chapter on the preparation of derivatives, which is a valuable feature of the book, includes the description and use of many of the reagents recently introduced, especially by American workers. A number of colour reactions have also been included, and include among others important tests like the Ninhydrin test and Millon's test, which are not to be found in the more usual books on the subject.

Part B contains a chapter on nomenclature followed by classified tables of organic compounds in order of their melting points or boiling points.

The volume under review is a welcome addition to the existing books dealing with the qualitative analysis of organic compounds. Exhaustive references to standard books and original papers and the bibliography at the end, enhance the value of the publication. Although primarily intended for under-graduate students, for whom it is suitable, the book will be found equally useful by post-graduate research students in organic chemistry. R. C. SHAH.

Sammlung Göschen des Wissen der Welt, I. Symbiose der Tiere mit Pflanzlichen Mikro-Organismen. By Prof. Paul Buchner. Pp. 123. **II. Geschlecht und Geschlechtsbestimmung im Tier und Pflanzenreich.** 1939. Pp. 110.

The series is intended to give encyclopædic information on a large number of varied topics of interest to the public, each volume being written by a specialist on the subject. In the first number of the series, Professor Buchner gives a vivid account of symbiosis —an association of organisms for mutual benefit—a subject which at first sight does not appear to be so vast. The author, in these pages, has shown the extensive nature of the phenomenon and has dealt with the various types of bacterial, algal and fungal relationships. The localisation, spread and significance of the different associations have been discussed and a number of cases of insect and plant or bacterial associations are mentioned. The author also gives the experimental work on symbiosis and the information of this phenomenon in the economy of nature.

The volume, though small, is nicely printed, well bound and profusely illustrated. There are a number of diagrams illustrating

the author's own researches. Although the book is a concise epitome of all the facts on the subject, it can be used with profit even by advanced research workers. An exhaustive and up-to-date Bibliography is included at the end of the volume.

The second number *Geschlecht und Geschlechtsbestimmung im Tier und Pflanzenreich* is another excellent volume in the same series. Prof. Hartmann has described in this volume the various types of sexuality and discussed both the haploid and diploid types of chromosome divisions. He has also traced the evolution of sex and quoted cases of *Chlamydomonas, Actinophrys, Spirogyra, Chilodon,* certain Gregarines, *Dunaleilla, Ectocarpus* and a few other forms to illustrate and elucidate the various steps. The chapter on Sex-chromosomes is well planned and written and the experiments on intersexuality are adequately described. The value of sex hormones in the physiology of development is also discussed. In the last chapter the author gives a brief account of the entire problem of sex and the theories connected with it. The volume is well illustrated. G. S. T.

Manual of Practical Botany. By Jagjivan Singh and Bhagat Ram Vasisht. (Ram Lal Suri & Sons, Anarkali, Lahore), 1939. Pp. 350. Price Rs. 3–8.

This is a treatise on Practical Botany brought out by two teachers of the Government College, Lahore. While it is mainly intended for the Intermediate students, in the words of the authors "it is hoped that students of the degree classes will also find much useful material in this book".

The subject-matter covers in a comprehensive manner, almost all branches of Botany and we have no doubt that the degree candidates will find here and there something useful for themselves.

Though almost all branches of Botany have been treated, we feel that this has been done in the usual hackneyed way, so commonly found in elementary books, of treating these branches as separate water-tight compartments. One would have preferred a more natural and admittedly a more desirable approach, in the shape of bringing into prominence the correlation between form, structure and function, at least so far as the Angiosperms are concerned. Nowhere can this close relationship be brought out with better advantage than in a Treatise on Practical Botany. Apart from this, we feel that the Histology portion has not received adequate treatment. Topics like the primary meristem, the fundamental distinction between stem and root structures, the course of vascular strands in the monocot and dicot stems, some details about wood, including annual rings, are some of the items which one would have wished to see treated in some detail.

Similarly the foliar concept of the floral organs could have been brought out in an elementary form. Especially is a true concept of the carpel an important pre-requisite for a correct understanding of placentation, sutures and the like. Only then will an elementary student understand correctly an expression like a unilocular bicarpellary gynæceum.

These observations, however, do not detract from the value of the book which is a useful guide to those for whom it is primarily intended. The three appendices form a very useful adjunct, especially the one on the collection and preservation of plants. On the whole the book is a welcome addition to the literature in the field of Practical Botany in which it cannot be said that there are already a large number of publications.

T. S. RAGHAVAN.

Practical Botany. By S. Williams and G. Bond. (Edward Arnold & Co., London), 1939. Pp. 96. Price 5*sh.* 6*d.*

The Indian student of Botany is very often accused of his tendency to learn things by rote rather than by critical observation. In training his critical and accurate powers of observation, the practical side of Botany has an important role to play. From this point of view one is glad to find in modern times increasing importance being given in Indian Institutions, to practical Botany. To any teacher of Botany in an Indian University, it is a familiar thing that at the commencement of each practical class, the Demonstrator takes a good bit of the time in giving instructions and often in going briefly over the portions already dealt with in the Lecture class, and which the students have to do in the practical class. Of late, however, work sheets are being issued to the students in advance, and it is their duty to conform to the instructions contained therein. This system of work sheets has the decided advantage of making the students more self-reliant rather than depend for

everything upon the Demonstrator. This does not, however, mean that the work sheet can replace the Demonstrator; nor does it seek to do it. It serves to save time and forces the student to come prepared to the practical class, as otherwise he comes in the confidence that he can learn what to do, at the beginning of the class from the Demonstrator's lecture.

The present book is more or less a compilation of the work sheets issued by the authors to the First Year students of Botany of the University of Glasgow. It may at once be said that not only will our Intermediate students be greatly benefited by a study of the book, but the degree candidates also will find much useful information throughout.

The book is divided into two parts, the first dealing with the morphology and physiology of Angiosperms and the second, with the other groups of the vegetable kingdom. Of necessity the second part is limited in scope and extent. But there is enough material in it to be of use to our degree candidates. The chapters on Angiosperm stamens, carpels, seeds, etc., contain much useful information not commonly found in elementary text-books.

In the first part, the salient features of Angiosperm morphology are given and the physiology portion has rightly received more attention. Greater emphasis has been deservedly placed upon general principles rather than upon mere terminology. One does not see for instance, the long list of terms used in the description of leaf form, texture and the like. Instead, the principles on which the arrangement of the mechanical tissues in the various organs are based, have been elaborated. The chapters on Xerophytes and Hydrophytes serve as a useful introduction to the study of the general principles of ecology and ecological anatomy.

In short, the book besides containing much useful information, is bound to serve the main purpose that any good practical book on Botany should, of developing the powers of observation in the elementary student of Botany.

T. S. RAGHAVAN.

Hand-book of Mica. By Ramani Ranjan Chowdhury. (Thacker Spink & Co., Ltd., Calcutta), 1939. Pp. xvi + 332. Price Rs. 15.

Mica has a unique combination of several desirable physical characters which makes it an extremely valuable mineral in the electrical, radio, aeronautical and several other modern industries, and with the rapid growth of these industries the demand for this mineral will be continuously increasing. As a constituent of several rock types though mica is widely distributed in nature, the commercially valuable deposits of the mineral are, however, confined only to a few countries like India, South Africa and Soviet Russia. India has been one of the chief producers of mica, but wasteful and unscientific methods of exploitation, careless grading of dressed mica, want of an intimate knowledge of international markets and their actual requirements and several other similar causes threaten the rapid deterioration of the Indian mica industry. Consequently, it seems to be necessary to take early steps to provide the Indian mica miners and mine owners with the necessary information relating to the modern methods of scientific exploitation, mining and suitable preparation of the mineral to the market. Publications which give an authentic and comprehensive account on mica mining, dressing and preparation for market are very few and even these are not easily available to many of the mica miners. Consequently, Mr. Chowdhury's book, *Hand-book of Mica,* recently published, may be stated to supply this want and will be a welcome addition to the scant literature existing on the subject.

The *Hand-book of Mica,* containing some 330 pages, is a comprehensive treatise on the subject dealing with various aspects including the geology of the mica deposits, the physical and chemical properties of mica, its occurrence and distribution, methods of prospecting and mining, preparation of the mineral for market and grading, built-up mica, mica products and their utilisation in industries, international markets for mica, etc. The book is divided into six parts containing 18 chapters in all, and 5 appendices and numerous illustrations.

The first part deals with the general geological aspects of the mica deposits, and the physical characteristics and chemical composition of the several varieties of the mineral. The next part gives a detailed account of the modern methods of prospecting, development and mining of the mica deposits, including some useful hints for locating and following up the workable mica deposits in India. Chapter V of this

part, dealing with the problem of wastage in mica mining, gives an idea of the inevitable waste of mica during the course of mining and dressing, and the proportion of such wastage to saleable material as experienced in different countries. Part III, which forms a large section of the book, describes the mode of occurrence and the geographic distribution of mica in India and foreign countries and contains much useful information on the different Indian deposits including their description, mode of working, fluctuations in production and export and similar other particulars. In parts IV and V, the author treats at great length the commercial preparation of mica and mica products and their utilisation in industries, and also describes the standard gradings of mica, their testing and specification, the impurities and inclusions contained in mica, artificial substitutes for mica, and the possibilities of producing artificial and synthetic micas. The final part forms an interesting reading dealing with the technique of mica marketing, international mica trade and the present and future outlook of mica industry in India.

The irregular, superficial working of the mica deposits leading to the abandonment of richer portions deeper down; the primitive, unscientific, wasteful methods of mining still in adoption in several places in India and the careless grading of sheet mica in entire ignorance of market requirements, which all lead to the deterioration of the mica industry in India are clearly emphasised. The author offers several useful suggestions in the book to save the Indian mica industry from its periodical stagnation and to place it on a satisfactory and stable basis.

The book, on the whole, forms a valuable monograph on mica and is highly useful to all who are interested in the Mica Industry and more so to those who are connected with the Indian mica industry. The price of the book, however, seems to be rather high which may prevent its being within the reach of many.

B. RAMA RAO.

Indian Refractory Clays. By H. Crookshank, B.A., B.A.I. (*Bulletin No.* 14, Industrial Research Bureau). Pp. vii + 63. Price Re. 1–6–0.

This small book gives in a convenient form a concise account of the refractory clays in India. The introductory chapter among other things, gives the nature and chemical composition of refractory clays and the effects of admixed impurities such as iron, titanium, lime and magnesia, and alkalies on the refractory qualities of such clays. Chapters II, III and IV describe the mode of origin, physical and chemical properties, and special uses of the refractory clays as classified under three well-recognisable groups—Sedimentary refractory clays, Kaolins and Lithomarges. The gist of information contained in these chapters is as follows:—

The Sedimentary refractory clays are of widespread occurrence in India and though some of the deposits occurring in the Gondwana formations are extensively worked near Jubbulpur for making fire bricks, etc., the others have been hardly touched. This is due to many obstacles existing for starting refractory industries in other parts of India. These clays are, however, largely suitable for ceramic industries also.

Kaolin or China clay results from the decomposition of felspar in the granitic rocks. The China clays are of different grades and though all are highly refractory only the poorest and the cheapest are used for refractory materials. The best qualities are used in the textile industries and the second quality Indian kaolins are finding extensive use in paper manufacture. Although kaolin deposits are numerous and widespread in India, many of them are not being worked. This is not due to want of sufficient demand in India, but in many cases the washed material produced at present in India, is not of sufficiently good and uniform quality to displace the more reliable imported China clays. However, with improved methods of washing the local material has been able to displace, to a fairly large extent, the imported China clay used for purposes of paper manufacture. The China clay deposits of India are comparatively small and are widely scattered and this, when combined with the limited demand for kaolin in India and our failure to use the different grades of kaolin to the purposes to which they could be advantageously utilised, will easily explain why the development of the kaolin industry has been comparatively slow.

Lithomarge is the decayed clayey material underlying the laterite and it is not of a uniform composition. It is not of any great economic use.

Chapter V gives the geographical distribution of all the known deposits of refractory clays in India arranged in a specified way according to Provinces and States in alphabetical order. Each of these deposits has a brief useful note containing all the information available on it. The information on the refractory clay deposits of Mysore, however, as extracted from older publications, is incomplete and not up-to-date.

There are 8 tables containing additional useful information, such as the analyses of Indian and foreign fire bricks, analyses of Indian refractory clays of some 89 samples from different parts; analyses of standard foreign refractory clays and similar other particulars. There is also a map of India showing the deposits of the three types of refractory clays described in the book.

It is needless to say that this handy reference book will be highly useful to those who are interested in refractory, ceramic and other allied industries in India.

B. RAMA RAO.

The Thyroid Gland and Its Disorders

1938 Transactions of the Third International Goiter Conference and the American Association for the Study of Goiter. (J. C. Hamilton, Goiter Publications, Concord Building, Portland, Oregon), 1939. Pp. 547. Price $3·50.

THE American Association for the Study of Goiter deserves the warmest congratulations of all medical scientists, engaged in the study of the thyroid gland and its disorders, for the initiative it has taken in getting together and publishing in book form the interesting and valuable transactions of the Third International Goiter Conference held under its auspices last year at Washington, D.C. Though goiter was first clinically recognised more than hundred years ago and considerable amount of knowledge has gathered since then, there are quite a number of questions which remain still unanswered. The International Goiter Conference has not only attempted to review and bring up-to-date the modern status of knowledge about thyroid disorders but, by many original articles and discussions contributed by some of the world-renowned specialists, has tried to indicate newer lines of thought and investigations. There is little doubt that the *Transactions* will be very welcome and largely appreciated by all keen students and teachers of the subject.

Starting off with an ably written *Foreword* and addresses of greetings from the President of the Conference, the Secretary of State for the United States Government and the Chairman of the Reception Committee, the subject-matter is presented in thirteen sections as follows: (1) Etiology—Radioemanation; (2) Prophylaxis; (3) Congenital and Childhood Factors; (4) New Growth and Infection; (5) Special Endocrine Aspects; (6) Surgical Aspects; (7) Medical Aspects, Cardiac and Renal Aspects; (8) Iodine; (9) Vitamins and Thyroid; (10) Research; (11) Metabolism and Basal Metabolic Rate; (12) X-ray; (13) Colloid Goiter. From the titles of the sections, it will be apparent that nearly all aspects of the thyroid problem have been touched and discussed. The arrangement of the various articles has been executed with commendable judgment, enabling readers with different fields of interest such as the clinician, the public health worker, the surgical specialist or the laboratory investigator to concentrate attention on their individual specialities easily. It is difficult to single out from such a formidable array of well-written articles by renowned workers any particular note for special mention, but presumably, writings from authorities such as George Crile, David Marine, H. Eggenberger, Henri Welti, J. B. Collip, F. H. Lahey, I. S. Ravdin and A. C. Wegelin will attract more attenton than others.

In the concluding lines of the *Foreword*, the American Association for the Study of Goiter states, "To the profession we offer this volume in the conscious pride of its potentiality—as a strategic and valuable reference work, to everyone directly or remotely interested in the fields of the study of Goiter". The Association, it must be admitted, has succeeded in its endeavour. The treatise is undoubtedly a valuable collection and presentation of current knowledge about the thyroid gland and its disorders. Superbly bound and richly got-up, with clear illustrations and neat Zinc-cuts, the volume will be a welcome addition to all medical institutions and post-graduate medical libraries.

B. MUKERJI.

The Philosophy of Non-Violence—A Scientific Approach

Mahatma Gandhi—*Essays and Reflections on his life and work—presented to him on his Seventieth Birthday, October 2nd,* 1939. Edited by S. Radhakrishnan. (George Allen & Unwin, Ltd., Museum Street, London), 1939. Pp. 382. Price 7*sh.* 6*d.* net.

BETWEEN scientific pursuits determined strictly under the rigorous conditions of laboratory control with perfected weapons of verification or demonstration, and hero-worship religious and political essentially and basically grounded on emotional admiration which is at the very antipodes of rational reflection and balanced judgment, a wide and practically unbridgeable gulf yawns, and from the scientific standpoint represented by a distinctive periodical like the *Current Science*, unique in the history of Indian technical journalism, it is undoubtedly difficult to review a volume like the present one in which sixty-three persons distinguished in their own way, men and women, Indians and Europeans, have paid eloquent tributes to Mahatma Gandhi on the occasion of his seventieth birthday. The Press in both hemispheres has welcomed the volume as one calculated to alter altogether the face of modern civilization built on force, exploitation and armament on a colossal scale. The volume is edited by Sir S. Radhakrishnan of the Calcutta and the Oxford Universities, now appointed Vice-Chancellor of the Hindu University at Benares. The Editor has contributed an "Introduction" on "Gandhi's Religion and Politics" (Pp. 13–40). The others, sixty-two in number, have not only paid their tribute to Mahatma Gandhi as an apostle of non-violence in thought, word and deed, but also commended non-violence as the only weapon of adjustment of individual, national and international relationship in a distracted modern world, the tributes varying in length from a short paragraph to a number of pages.

The publication of the volume would afford the occasion for discussing the philosophy of non-violence as a weapon of adjustment of secular affairs. In addition to the entire mass of Gandhian literature now available, the volume under notice should be studied against the background supplied by a sensational work like "Gandhi and Anarchy" written by the late lamented Sir C. Sankaran Nair. To-day poor Mr. S. Srinivasa Iyengar seems to be the solitary person who, day in and day out, tirelessly tells audiences steeped to the point of saturation in Gandhi-worship that Religion and politics should be separated from one another. Political memory is so conveniently short. In a way, Nemesis appears to have overtaken Mr. Srinivasa Iyengar. For, it was he who, once upon a time wanted the spiritualization of politics.

Be that as it may, what is the philosophy of Non-Violence? Is it possible to proceed along a strictly scientific approach? There is universal agreement on what constitutes scientific verification. A suggested law or hypothesis should be verified in reference to Positive test-instances as well as Negative test-instances. Then alone the hypothesis would rank as a verified Universal Law. Pure psychological analysis would reveal the existence of *three* types of conflict: (1) Individuals come into conflict with one another in the matter of their rights and privileges. (2) Individuals come into conflict with the State. (3) States and Nations come into conflict with one another. Other types may easily be subsumed under these. Since the dawn of reflection, a life of love based on non-violence has been commended as the ideal by all thinkers and seers. The Vedantic system-builders, Christ, Buddha, and others have all proclimed and praised the gospel of non-violence. Latterly, Tolstoy added emphasis to it. Mahatma Gandhi, thus, by no means is the first to have proclaimed the gospel.

Non-violence in *thought* will never admit of laboratory verification. Thoughts violent and non-violent, being too subjective, will never lend themselves to verification under laboratory control. Non-violence in word and deed being objective or involving consequences and effects in the objective world from which appropriate responses must be elicited, would be capable of verification. Before Non-violence is admitted to be a gospel universally applicable and universally valid, positive and negative test-instances should be furnished. That is to say, Non-violence and the promised millennium or even limited returns in material and spiritual currency should be shown to be casually connected with one another in a number of positive instances. Even so, it shoud be shown that *absence* of non-violence is invariably and unconditionally linked with the *elimination* of the consequences, namely, the millennium or the limited returns. Then, and then alone, would verification be complete. Proceeding along this line of

investigation, it would not be difficult to demonstrate that Non-violence can *never be universalized.* If, to err is human, a certain amount of violence is included in the error. To be violent is human.

If emotionalism, sentimentalism and time-serving loyalty to this or that creed be eliminated, the reason why Non-violence *cannot* be universalized would be immediately apparent. Unless both the parties to the conflict or controversy admit the validity of non-violence, its one-sided exercise would mean victory for one and total extinction or annihilation for the other. I do not know if it is at all true. Mr. George Bernard Shaw is believed to have administered a knock-out blow on the head of the doctrine of non-violence. He seems to have emphatically stated that the non-violence of the Cow would never convert the Tiger into a vegetarian.

The argument that if Belgium had remained *strictly* non-violent in thought, word and deed, if Abyssinia had followed suit, and if to-day the Jews and the Poles had remained non-violent in thought, word and deed, the war-mongers would have been discomfited, can be advanced only by those whose kith and kin, person and property are all protected and guarded by others. Mr. Arthur Moore, Editor of the *Statesman*, Calcutta, an ardent admirer of Gandhi and Radhakrishnan, observes that the Pacifist argument was refuted by Krishna in the *Gita*, and that Gandhi held the argument of the *Gita* did not apply to physical war. Both views are untenable. The Lord Krishna has definitely stated that War is used by Him to rid mother earth of the burden of arrogant mankind. Yet, pacifism is the ideal of all who aim at realization of the Supreme Self Immanent in Reality. Pacifism can never be a political prophylactic or panacea. Nobody could have forgotten Gandhi's great argument that the Behar Earthquake was due to the treatment meted out to untouchables. If war, even as evil, is a permanent factor of the cosmos which God Himself employs to rid mother earth of her burden, and if the pseduo-pacifists advocate the turning of the left cheek in all crises and emergencies, they must be deemed to be working against God. Let there be no illusions, however. I am afraid within the limits of this notice, the philosophical problems cannot be argued out. In God's universe, there is as much place for war as for peace, as much for good as for evil. One thing is certain. Unless politics and religion are kept rigidly separate from one another there would be only pinchbeck politics, simulacrum of spirituality and rope-snake religion.

Amusing errors occur in the volume, citational, interpretational, and typographical. I leave it to the readers to discriminate which is which. (1) On page 32 occurs the citation *Frano Virat*, which a distinguished person in Madras, one very near the Rose if not the Rose itself, read as *Franco Virat* in view of the recent successes of General Franco in Spain! It is a pity the Editor did not give the exact reference. It is from the Whitney's translation of *Atharva Veda.* It should be "*Prano*", and not as actually printed. The text in the said context means something which has absolutely no connection with Satyagraha, Love, etc., in support of which it is cited. (2) A truncated sentence is cited from the *Isavasya* Upanishad on page 19. No reference is given. It is cited to support the dictum "love thy neighbour as thyself", "*atmaiva*". In a book intended to inculcate non-violence as a Universal Gospel, I submit it is a violent outrage to translate or interpret "thyself" into "*atmaiva*". The text sings the glory of the spiritual vision of the blessed "*Adhikari*" who sees God in all, and all in God. (3) A. Berriedale Keith who divides his researches between Panditry in interpreting Indian and other Constitutions and Panditry in Sanskrit Literature, does great violence indeed to a popular Sanskrit stanza which every school-boy is expected to know. The correct quarter is "*Ayam...Nijah...paro-veti*" and not as actually printed. (4) But, the funniest error is that Srimati Sophia Wadia is said to be the founder in India and Editor of the Indian P. E. Z.! (P. 295.) It should be P. E. N. (5) Finally, Dr. Muirhead, General Editor of Library of Philosophy series, in which Sir S. Radhakrishnan's volumes on "Indian Philosophy" have appeared, writing on the "Hindu Idea of Truth" again, does great violence to the Vedantic Concept of Truth and Reality. Propositional quibbles and legerdemain like "Truth is God", "God is Truth", will not bear a moment's metaphysical scrutiny. The Vedanta long ago rendered a most satisfactory answer to the problem in question. God was deliberately and definitely defined as the Creator of the World, its protector, destroyer, etc. ("*Janmadyasya Yatah*"). The God of Philosophy thus defined has nothing to do with the Truth that H_2O is water or that Philosophers care as much for their monthly salary as others.

In any scientific study of the philosophy of non-violence, the following facts should be borne in mind: (1) Rama admitted to have been God incarnate had to wage war. (2) Krishna did the same. It is recorded in the epic that even the exhibition of the Lord's cosmic form did not move Duryodhana. Balarama, unable to prevent war, went on a long pilgrimage. Vyasa did not prevent the Mahabharatha War. He was God incarnate. Krishna did not. Indian philosophy may be good, bad, or indifferent. If hopes are entertained in any quarters, and if the claim is seriously advanced that International dispute and dissentions should be settled by reference to any Indian or European Panchayat of Pacifists, those who urge such claims and those who lend their ears to them cannot but be considered to be doped denizens of *limbus fatuorum*. Modern countries which, for whatever reasons of ideology and whatever causes of equipmental incapacity, fail to arm themselves to the teeth as it were, fail to keep the powder dry, of course with plenty of faith in God, and fail to adopt modern methods and weapons of warfare, would be permanently at the mercy of the aggressors. If modern governments have paid police to protect persons and property they should have paid Military Units as well. On the plane of reason, there is no escape from this conclusion.

R. NAGA RAJA SARMA.

Sugar Industry of India, 1937–38 *

THE year 1937–38 was an eventful one for the world sugar industry. The International Sugar Conference allocated export quotas among the various sugar-producing countries. No quota was however allotted to India, this country having agreed not to export sugar to any other country except Burma. The world sugar production during this year was 30,991,000 tons, showing an increase of 173,000 tons over the previous year while the sugar consumption during the same period was 29,757,000 tons showing a decline of 792,000 tons.

In India the total area under sugarcane during 1937–38 was 3,815,000 acres showing a decrease of 14% from the last year and similarly, the total cane grown was also less by 17·4%. The season was not quite favourable as the crop suffered from insufficient rain in its initial period. Owing to shorter duration of the season and inadequate supply of cane there was a large decline in the production of white sugar which was 930,700 tons as against 1,111,400 tons of last year. The total number of factories that operated this year was 136. White sugar production by the indigenous process was 125,000 tons as against 100,000 tons of the previous year.

During the year 1937–38 there were no changes in the rates of excise duty on sugar or on the import duty on foreign sugar and molasses. Export of sugar from India by sea was 14,296 tons as against 521 tons of the previous year. Imports of foreign sugar showed a sharp decline to 13,715 tons from 23,100 tons of last year. Only a small portion of the sugar required for consumption in India was thus imported because the production in the country almost balanced consumption.

There was a decline in the 'gur' production from 4,268,000 tons last year to 3,364,000 tons—about 21%. The total production of molasses in the Central Sugar Factories, working directly with cane amounted to 349,600 tons. Though separate figures for export of molasses by sea are not available, the total export of molasses, palmyra and cane jaggery during 1937–38 was 79,167 tons while the figure for the previous year was only 24,195 tons.

The record production of sugar in the year 1936–37 brought with it a phenomenal decline in sugar prices which led to a drastic reduction in the area cultivated for cane and sugar produced in the following year 1937–38. This curtailment, in its turn, resulted in a rise of price in Indian factory sugar till they reached the parity level with imported sugars, which is acting again as an incentive to the growers for planting more cane. With the continuation of these conditions, there is always the danger of overproduction with its attendant difficulties following a period of prosperity. It is desirable, therefore, in the interest of the stability of the Indian Sugar Industry, that any future programme of cane cultivation and sugar production must be so planned as to assure both the grower and the manufacturer a fair margin of profit over a number of years while the consumer also pays no more than a reasonable price for sugar.

G. GUNDU RAO.

* Review by R. C. Srivastava, Supplement to the *Indian Trade Journal*, November 2, 1939.

Recent Advances in Applied Mechanics

Proceedings of the Fifth International Congress for Applied Mechanics. (Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., London), 1939. Pp. xxi + 748. Price 30*sh.*

THIS publication is a unique collection of more than one hundred papers dealing with the subject of Applied Mechanics. They represent the work of many eminent research workers gathered together for the Fifth International Congress of Applied Mechanics held at Cambridge (Massachusetts U.S.A.), during September 12–16, 1938. The papers are classified under the heads:—

(1) Elasticity and properties of Materials: There are 47 of these preceded by three general papers. (2) Mechanics of fluids: These are 66 in number, of which three are of a general character. And (3) Dynamics. There are 17 papers in this Section. Although some of the papers are purely theoretical and mathematical in character, the bulk deal with the application of theory to problems of great practical importance to the engineer. Experimental methods for testing the truth of the theory are described in a number of them and conclusions drawn to serve as a guide for the future progress in design. It would probably be invidious to select from among the papers, but the following references are merely given as samples.

Dr. D. M. Smith of the *Metropolitan Vickers* has contributed a paper in which an attempt is made to estimate the stress and deflection in a built-up half diaphragm as commonly used in Impulse Steam Turbines. The deflection is obtained by calculating separately the deflections of the centre and of the blading assuming a certain distribution for the supporting reactions round the periphery. Curves are given for enabling ready calculation. The values as deduced by this theory were tested experimentally by loading of a large number of diaphragms by means of hydraulic rams. The agreement was very satisfactory, especially in the case of diaphragms with relatively thin centres.

A study of the stresses and displacements in two-hinged Vierendeel Truss arches is made by Professor Maugh of the *Michegan University* with the aid of brass and celluloid models. Some of the conclusions drawn are of general interest in the design of continuous frame structures, notably the one about the stiffness being dependent on the physical characteristics of the joints, and the possibility of the joint-action being expressed in suitable slope-deflection coefficients.

A method of measuring "integrated roughness" of surfaces machined or hand finished is described by Pierre Nicolaw making use of an apparatus which is called "Micrometre Pneumatique Solex". Air is allowed to escape through a specially constructed orifice placed over the surface whose roughness is to be measured. A scale of roughness could be constructed from the quantity escaping which is observed by a manometer measuring the air pressure.

Professor H. F. Moore of Illinois and R. L. Jordan contribute a paper on stress concentration in steel shafts with semi-circular notches based on an experimental study. Fatigue tests were made with the Standard Woehler Type of machine.

The problem of failure of materials under combined stresses forms the subject of an experimental investigation by Prof. Lessels and Mac Gregor of the Massachusetts Institute of Technology. The hollow test bars were subject to internal pressure and at the same time, axial tension. The lateral strains were noted with a newly developed hydraulic lateral extensometer which gave the average strain over a considerable gauge length from the displacement of a quantity of water placed in a metal jacket surrounding the test piece. It is stated that the constant energy of distortion theory was well supported by the test results.

The application of Photo-elastic methods of studying stress problems is described in three papers. The beautiful photographs illustrating the "Frozen Fringe Patterns" obtained with a transparent bakelite test piece by M. Hetenji, as well as other investigators described in these papers indicate that in this method the research worker has in his hands a valuable tool giving

a visual picture of the state of stress in a body.

An automatic relaxation machine to measure the creep properties of a metal stressed under high temperatures was used by Dr. A. Nadai and J. Boyd of the *Westinghouse Research Laboratories*. The work was undertaken with special reference to bolted flanges where the total deformation (elastic + plastic) remains constant and creep takes place under decreasing stress. The work is stated to be still in progress with a view to present a comparison of the test results obtained with creep data already available under a condition of constant loading.

In the section of Mechanics of Fluids, Mr. C. H. Chatfield of the *United Air-Craft Corporation*, U.S.A., surveys in a paper the entire field of development of the air plane structure along with the engine. No part of the aeroplane has been left untouched in this connection. The problems that have confronted Aeronautical Engineers in the past have been carefully analysed and the ways by which successful solutions were obtained are described in a clear and concise manner. Trends in future design both as regards new material and its application are predicted and the conclusion is drawn that research in applied mechanics would be of great help as in the past to the aeronautical engineer in overcoming his special difficulties leading to steady progress.

The phenomenon of turbulence in fluid motion is the subject of a number of papers. The statistical theory is discussed in several papers by Professor Th. Von Karman, Professor Norbert Wicner and others. Professor Kampe de Feriet of the *University of Lille*, France, describes some researches in this connection made to measure the diffusion of very small soap bubbles (3 to 4 m.m. in size) in vertical and horizontal wind tunnels.

The reduction of drag in air-craft is of paramount interest and there are a number of papers dealing with this subject. The effect of surface roughness is the subject of an experimental study by E. F. Relf of the *National Physical Laboratory*. A model of the R. 101 air-ship envelope about 4 feet long was tested. The effect of rivet heads, lapped plates on aerofoils was also studied. Full-scale tests generally confirmed the deductions from model work. Dr. William Bollay of the *Harward University* develops a theory applicable to planing surfaces like sea-plane floats, explaining the differences observed by experimenters between the behaviour of air-foil and gliding surfaces.

The lines of flow in an aerodynamic field are studied by Professor J. Valensi (Marseilles), with the aid of smoke consisting of air charged with ammonium hydrochloride. The injection of the smoke is either continuous or in puffs whose frequency may be regulated. The flow lines are observed by illumination from a source of light which may vary to give a stroboscopic effect or may be continuous. Motion round propeller blades, and different wing profiles have been studied.

Professor Knapp and Dr. Ippen contribute a paper on the characteristics of "shooting flow" in open channels round curves. In a long curve a series of rises and falls in level occur both along the outer and the inner walls of the channel and this pattern persists to a considerable distance downstream. A tilting platform 100 feet by 10 feet was used to vary the slope in the experimental channels. These experiments were necessitated by the concern felt by the engineers over the design of curves for the storm water channels of the Los Angeles County Flood Control. It is stated that sills and transition curves suitably placed damp out the disturbance pattern appreciably in the case of rectangular channels.

The mechanics of sediment suspension is a subject of topical interest to hydraulic engineers the world over with reference to irrigation, river-regulation, &c. Some experiments to elucidate this matter conducted by Professor Rouse of Pasadena are described in a paper. A theory is developed for the distribution of sediment under equilibrium conditions based on the analogy of an expression which has been used for the transport of momentum per unit fluid volume in a liquid in which fully developed turbulence exists.

The question of transfer of heat across metal partitions under conditions leading to evaporation of liquids at a high or low pressure is the subject-matter of a paper by Professor Max. Jakob of Chicago. The coefficient of heat transfer in tubes (such as are used in boilers) under such circumstances is higher than in wide vessels. A formula is developed based on various assumptions to apply to the case of horizontal or vertical walls, and fairly good agreement has been

found experimentally but it is admitted further work is necessary. The effect of vibration on heat transfer from a horizontal cylinder is studied by Professor Boelter and Martinelli with the aid of a special apparatus devised by them.

The phenomenon of cavitation is studied by Professors H. Peters and B. G. Rightmire by the vibratory method using a brass test specimen screwed into a nickel tube and vibrating in fresh water, the vibrations being produced electrically. The test results lend support to the hypothesis that the damage suffered under these circumstances is due to a series of impacts produced on the specimen by the periodic collapse of vapour at the vibrating surface.

Four papers on the mechanism of fluid film lubrication in journal bearings are included. There has been a vast amount of work in this field and both research and theory have enabled one to form a fairly correct picture of what is happening. Recently the effect of pressure in increasing the viscosity has been studied. This is of importance in heavily loaded bearings like those of roll necks of rolling mills. There is then the phenomenon of oil film whirl or instability in the position of journal producing objectionable vibrations. The application of the results of research to the field of practical bearing design is still not so well established as one would desire. The work done in the United States regarding these problems is presented in the form of a summary by Professor Karelitz, De Newkirk and Needs, members of the special research committee on lubrication appointed by the *American Institution of Mechanical Engineers.*

In the Dynamics section, Dean A. R. El. Sawy of the *Egyptian University* contributes a paper on a method of computing the I.M.E.P. of an internal combustion engine working on the 4-stroke cycle. It is stated that the point in the stroke where the pressure is equal to the mean effective pressure is the same for all the cards taken from an engine in normal operation at different loads and speeds. Theoretical and experimental work in support of this contention is offered.

The measurement of transient impact strains by the change in electrical resistance undergone in a thin strip of elastic material cemented to the strained surface is described in a paper by Professor De Forest, of the *Massachusetts Institute of Technology.* The changes in strain could be recorded photographically by means of the Cathode-ray Oscillograph. A check calibration was carried out using a U-shaped metal bar and allowing it to vibrate as a tuning fork. The recorded strain was compared with that obtained by calculation from the St. Venant Formula. The difference was only ½ per cent. It is stated that this method enables one to measure stresses propagated at the speed of sound and "impact strains need no longer remain in the realm of conjecture".

The subject of vibrations and their cure from the topic of a number of papers among which may be mentioned the following: "Vibration Isolation of Air-craft power plants", by E. S. Taylor and K. A. Browne. "Sur La Suppression Des Vibrations a Bord des Grands Paquebots", by Henry Beghin. The latter has reference to the disturbing vibrations experienced in the ship "*Normandie*" when she first put out to sea. The paper on "Spiral" vibration of rotating machinery by R. P. Kroon and W. A. Williams contains a theory based on the hypothesis that temperature distortion of the roter is responsible for the continuous change in unbalance observed under these circumstances. A simple test set-up was used to check up the theory. Further work is considered desirable, to reduce the number of assumptions that are made in what is stated to be a preliminary investigation.

The Cathode-ray Oscillograph is employed by Professor Draper and Philip M. Morse for finding the size and location of the region of detonation in an Internal Combustion Engine. The application of acoustic theory of standing waves is made in this connection. Use was made of the properties of these waves as predicted by the theory and instantaneous pressure Oscillations were simultaneously observed at two different points within the engine cylinder. An interesting conclusion made by the authors is that the detonating region is next to the cylinder wall and often has a greater spread along the wall than away from the wall.

This collection of papers is thus of very great interest and importance to workers even in kindred subjects and the new methods of attack described offer great scope for further research. The typography and get-up leave nothing to be desired and the illustrations and graphs form additional attractive features.

E. K. RAMASWAMI.

CENTENARIES

Cockburn, William (1669–1739)

WILLIAM COCKBURN, a British physician, was born in 1669. After taking his M.A. at Edinburgh, he proceeded to the University of Leyden of which he became an M.D. In 1694 he was appointed naval physician and he seems to have retained this position till 1731, when he joined the staff of the Greenwich Hospital. Cockburn was physician to Jonathan Swift.

Remedy for Dysentery

Cockburn had a secret remedy for dysentery. In July 1696, when he was dining on board one of the ships, Lord Berkeley remarked that 'there was nothing farther wanting but a better method of curing fluxes'. Cockburn announced his secret remedy which when tried next day upon seventy sailors proved a brilliant success. The result was reported to the Admiralty Board and the remedy immediately came into official use and remained so for forty years, not only in the navy, but also in the army. This was looked upon as a benefit of national importance and William III personally conveyed the nation's thanks to him, although he was bitterly opposed as a quack by academical physicians. Nothing is now known of that wonderful remedy.

His Writings

Cockburn was a writer of some importance. His only contribution to the *Philosophical transactions* of the Royal Society was on "The operation of a blister". Its object was "To give a reasonable conjecture how a blistering plaister, the chief ingredient of which is cantherides, may cure a fever, and its most terrible symptom, a delirium, and that in a few hours".

His Writings

His first book was on the *Nature and cure of distempers of seafaring people with observations on the diet of seamen's in H.M.'s navy* (1696). In those days there was no notion of the importance of succulent vegetables in this matter; hence Cockburn's sarcastic remark that people "at the name of scurvy, fly to scurvy-grass, water-cresses and horse-radishes". His other books were on the *Lues venerea* and on the *Symptoms, nature and cure of gonorrhœa.* The latter went through four editions and was translated into other languages.

Cockburn died at London November 1739.

Hewson, William (1739–1774)

WILLIAM HEWSON, a British anatomist, was born at Hexham, Northumberland, November 14, 1739. Having been apprenticed to his father who was a surgeon, he studied at St. Thomas's and Guy's hospitals and attended the anatomical lectures of William Hunter. Later he became a partner of Hunter in his anatomical school. But the partnership broke and in September 1772 Hewson began to lecture independently at a theatre which he built near his house. His reputation was so high that he had no difficulty in attracting a large class.

His Researches

Hewson's researches on the blood were of great importance as establishing the essential character of the process of coagulation and the forms of red corpuscles in different animals. He also made valuable contributions to the study of the lymphatic system in fishes.

His Publications

Hewson's first book came out in 1771 under the title *An experimental enquiry into the properties of the blood.* He wrote two more books, one on the lymphatic system and the other on the red corpuscles. Besides these he wrote about ten papers, most of which were published in the *Philosophical transactions* of the Royal Society. His *Opera omnia* was published in Leyden in 1795, while an English edition of his *Collected works* was brought out by the Sydenham Society in 1846.

His End

Hewson wounded himself while making a dissection and serious symptoms followed. He died after a few days' illness May 1, 1774.

Murdock, William (1754–1839)

WILLIAM MURDOCK, a British engineer, was born at Bellow Mill, Ayrshire, August 21, 1754. Brought up as a gunner—his father and grandfather were so—he entered the service of Boulton and Watt at Soho in 1777. Murdock's unambitious career was entirely devoted to the interests of his employers. He had no leisure to devote to any sort of recreation. The rising sun often found him after a night passed in incessant labour still at the anvil or turning lathe, for with his own hands he would make those articles he would not trust to unskilful ones.

The First Locomotive

His fame had been somewhat overshadowed by the great name of Watt. But the first locomotive was made by Murdock. It was constructed entirely by his own hands. One night, after returning from his duties, he wished to put to the test the power of his engine, and as rail roads were then unknown, he started the locomotive in a dark night on a narrow path in the church compound, himself in full chase after it. Shortly after, he heard a distant despair-like shouting; he soon found that the cries for assistance proceeded from the pastor of the church who, going into the town on business, was met in this lonely road by the fiery monster, whom he subsequently declared he took to be the Evil one in *propria persona.*

The First Coal Gas Light

Murdock is still better known to the public and most deservedly so, by his invention of

applying the gas from coal to economic purposes. Although the gas had been discovered and obtained both naturally and artificially more than half century before, nobody had thought of this application. He perfected the mechanism for such a gas light and described it in the *Philosophical transactions* of the Royal Society in 1808. This earned him the Rumford gold medal of the Society.

PNEUMATIC INVENTIONS

Murdock had made many mechanical improvements in the equipment of the Soho Foundry. Prominent among them is the construction of the first pneumatic lift for the purpose of raising and lowering the castings from the boring mill to the level of the foundry. He was also the first to make use of compressed air to ring the bell in his house and in the office. He was the inventor of Cast-Iron Cement which is now so much used in the construction of engines and machinery. He invented a crown-screw by which marble and stone could be bored for use as water pipes.

HIS END

Murdock was also the first to invent central heating. While engaged on the erection of this apparatus at Leamington, he met with a severe accident by the fall of a ponderous cast-iron plate upon his leg above his ankle. He never recovered completely from the effects of this injury.

Murdock died November 15, 1839.

ASTRONOMICAL NOTES

Planets during December 1939.—Venus continues to be an evening star and will be visible low down in the western sky for about an hour and a half after sunset; Mercury will be at its greatest elongation from the Sun (21° 25'W.) on December 17 and can be seen for a short while before sunrise. Mars is rapidly moving eastwards in the constellation Aquarius and although decreasing in brightness, will still be a conspicuous object in the western sky in the early part of the night.

Jupiter will be on the meridian at about sunset and continues to be well placed for observation. Saturn moves slowly in a retrograde direction near the western border of Aries and becomes stationary on December 29. The rings can be seen fairly widened, the angular dimensions of the major and minor axes being 43" and 10" respectively about the middle of the month. Not far eastwards of this interesting planet, will be Uranus which can be easily located about 2° south of the star δ Arietis (magnitude 4·5). Neptune is in quadrature with the Sun on December 18, and is stationary on December 29. It is situated about a degree to the north of β Virginis and can be observed with some optical aid. A lunar occultation of some interest that will be visible in India is that of β Capricorni (magnitude 3·2)) on the evening of December 14.

Jupiter X.—Two extremely faint satellites (X and XI) of Jupiter were discovered last year by Dr. Nicholson at the Mt. Wilson Observatory. From the revised orbit of J. X published by R. H. Wilson (*P.A.S.P.*, August 1939), it is found that the mean distance is ·077 astronomical units and the period 252·8 days. The orbit of this satellite appears to be very close to those of J. VI and J. VII. T. P. B.

MAGNETIC NOTES FOR OCTOBER 1939

MAGNETIC ACTIVITY.—The terrestrial magnetic activity during October 1939 was larger than that in the previous month. There were 6 days of *moderate* disturbance, and 16 of *slight* disturbance. The number of days of *great* disturbance was only one while 8 *quiet* days occurred during the month.

It is interesting to note that the most disturbed day in the month that of 13th October occurred immediately after the 12th October which is the quietest day during the month. The distribution of the magnetic characters* of individual days is shown in the table below.

Dates of the month	Quiet days	Disturbed days		
		Slight	Moderate	Great
1939 Oct.	8, 12, 20, 24, 25, 27, 29 and 31	1, 2, 5 to 7, 10, 11, 16 to 19 21, 22, 26, 28 and 30	3 4. 9 14 15 and 23	13

Magnetic Storms.—A storm of great intensity with "sudden commencements" in H, D and Z, was recorded on the 13th and 3 moderate storms each with a gradual beginning occurred on 2nd, 9th and 14th respectively. The number of disturbances during October 1938 were three (one great on 7th, and 2 moderate on 23rd and 25th).

Monthly Characters.—The mean character figure for October 1939 is 0·97 as against 0·94 for the corresponding month of 1938.

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* For method of characterisation please see "Magnetic Notes for July, 1939," in *Curr. Sci.*, 1939, **8**, No. 9, 434.

Perspectives in Evolution*

A CORRECT understanding of the implications of the rapid discoveries being made in Zoology since the beginning of this century can only be had by an examination of these discoveries with reference to the long range view of the existence of life on this earth and this is the thesis examined by Prof. Ritchie in his address to the Zoology Section. The first of these long range views concerns the origin and nature of life. The author examines the mechanistic and vitalistic conceptions of life, the vortex theory, the equilibrium theory and also the bearing of enzyme actions on the understanding of life's processes but concludes that none of these ever offers a complete understanding of its mystery and secret. The characteristics of life are very different from the characteristics of lifeless things and in fact the processes governing the actions of the two are different and are probably completely opposite. The power exhibited by living organisms to abstract from the atmosphere, their medium and generally from their environment, materials that are found in very small quantities, is one which has no parallel in nonliving things, for physical laws tend towards a maximum dispersal of their particles instead of their segregation. But yet the actual mode of the origin of life on earth eludes us. It may be said that life originated as a result of a concourse of atoms but this is more a possibility than a probability. It is impossible too, to say what the first living thing looked like, whether it was a virus, a bacillus or just an undifferentiated mass of protoplasm capable of reacting to its environment. It therefore becomes necessary to take the origin of life as an axiom and once this is done, all the different biological phenomena become explicable.

There is still another concept of life which is as breath-taking as it is baffling. It is now estimated that life has existed on the earth for perhaps 1,200 million years and that the earth itself is about 2,000 million years old. Against this stupendous background of time has Evolution been progressing, slowly and with limitless patience. Against this background man appears but an insignificant thing, his part in evolution a microscopic one, his activities but a tenuous struggle. He appeared on the earth from 25,000 to 40,000 years ago but only very little of this period—in fact only the last 300 years—has witnessed any of his great transformations. As Prof. Ritchie picturesquely puts it, man's achievements have been crowded into less than one-tenths of a second of a twelve-hour past life of the earth.

There is yet a final question which Prof. Ritchie asks,—what of the future of Man? If we assume that life will continue on earth for as long as it has existed already, it must be admitted that evolution will continue. What will the human being at the end of earth's life look like? Nobody can tell. Science is unable to forecast the long future of evolution. It has often been said that man is the culmination of evolution and the future of evolution must only consist in a development of individuality of mental and intellectual ability and in the perfection of a great social order. But when the huge past of over a 1,000 million years has produced such a wealth of evolution, is the huge future of about the same period likely to produce nothing more or better than just a better man? It is on the other hand more probable that man is but a stage in life's progress, just as the dinosaurs were in the Triassic period. And what the future lines of this progress are, nobody can foretell, nor even imagine.

* Summary of the Presidential Address by Prof. J. Ritchie, Zoology Section—Brish Association for the Advancement of Science, Dundee, 1939.

The Assessment of Physical Fitness*

EVERY one talks glibly of Physical Fitness. Many are unaware of its implications. Diverse definitions are given and though we are generally aware of the many qualities that a fit person should possess, we are unable to test those qualities in the light of what is expected of them. Is it a good configuration of the body, is it physiological efficiency or is it the possession of a superior mental equipment that is the criterion of physical fitness? This question is examined by Prof. David Burns in his address to the Physiology Section. It must be admitted that data regarding the form and stature of the body are valueless in testing physical fitness and an undue emphasis on somatometric assessment alone is liable to mislead us. It is true certain initial advantages or disadvantages are conferred on subjects who are endowed with positive or negative qualities regarding form and stature of body but only when they are associated with other functional qualities are they of any value in assessing physical fitness. Physical fitness is primarily physiological. Of the different kinds of measures of physiological fitness indicated, the most important are the efficiency of the functioning of the cardio-respiratory mechanism, the rate of heat loss under different conditions and the value of muscle tone. On the other hand, the quality and state of mind are also of great importance in assessing physical fitness and there is really a close correlation between the state of one's mind and the amount as well as quality of functional activity one is able to put in. It may be true that man was asked to earn his bread by the sweat of his brow, but there was really no intention of precluding him from taking a joy in his work. In fact, in this the secret of efficiency lies. "Our natural strength lies in our men and women and not in the machines that they tend or the battleships that they man. To be really great a State must have citizens fit in body as well as in mind."

* Summary of the Presidential Address by Prof. David Burns, Physiology Section—British Association for the Advancement of Science, Dundee, 1939.

Measuring the Mental*

R. J. BARTLETT in his Presidential Address has attempted a fairly exhaustive survey of the field of Experimental Psychology with special reference to practical achievement in terms of "Measurement" of the phenomena studied and investigated by Psychology. Reference is made at the outset to the existence of divergent views on the matter and manner of measurement in psychology. Prof. Spearman asked if the data of psychology would admit of what is properly called measurement. Dr. William Brown interested in medical psychology would appear to deny the possibility of measurement of mental phenomena. Malebranche, Leibniz, Kant, and some physicists have ruled all measurement out of order in psychology. Notwithstanding all this, the term "measurement" has come to stay in the literature of psychology. Experimental Psychology is a little over fifty years old. The Presidential Address reviews Experimental Psychology bringing out the senses in which the term "measurement" is being used by psychologists.

Metre scales and foot-rules, balances and weights, chronoscopes and stop-watches, resistance boxes, galvanometers, photometers, *et hoc* are used by Experimental Psychology. Results of bodily activity carried out under controlled conditions were measured. The Gaussian continuous function would as well represent the law of distribution of the results of the bodily expression of mental intention. After referring to the reaction-time-experiment and measuring of the scatter value, R. J. Bartlett discusses at considerable length the Weber-Fechner Laws, and indicates the conclusion that "experiments have measured not the sensitivity of sensory discrimination but rather, the 'constant error' due to the regression of the memory image of the first stimulus towards the values of the central zone of adaptation". The Address then deals with the physiological concomitants of emotional experience, and the so-called Intelligence Tests. Of course, in any discussion of the Intelligence Tests, Prof. Spearman's G (general ability) and S (special aptitude) must appear.

When physical measurement is impossible, R. J. Bartlett proceeds to observe, rankings will have to be secured. Colours, pictures, persons, poems, holiday resorts,—I may add favourite film stars—can be arranged in order of preference. The Technique of ranking and grading of attitudes and preferences is explained in detail. Reference is made to Thurstone and Chave's *Attitude to the Church Scale*. R. J. Bartlett concludes his fine presidential pronouncement with a modest claim that all he has been able to do is just to have sampled the methods and results of Experimental Psychology trusting the sample is a fair one.

Two important and significant conclusions emerge from the Presidential Address just summarised. (1) In the first place, the demand made in certain quarters that unless the data of psychology lend themselves readily to quantitative measurement of the type familiar in physics and chemistry one should not accord any recognition to psychology as a science or a systematic science at all has to be judged to be an illegitimate demand as the data from their very nature and constitution do not admit of such exact measurement as noticeable in the case of dead, inert subject-matter. (2) In the second place, measurement of *some distinct sort* is possible in psychology if one should agree to regard, "ranking, grading, and rating..." as processes of measurement.

These two conclusions valuable as they are do not suggest or claim the existence and operation of any fool-proof methods, and instruments of measurement. Serious difficulties are inherent in the very constitution of mental phenomena as distinct and contradistinguished from the physical which under certain well-known circumstances absolutely defy quantitative determination and precise measurement. The well-known classic instance of one smiling and smiling and yet being a damned villain is by no means confined or restricted to the geographical or territorial limits of Denmark. Violent emotions that are furiously agitating the minds of many can successfully be controlled by an adroit effort at dissimulation, the external bodily expressions being reduced to the barest negligible minimum. If conclusions and generalisations in psychology are to be based on such external expressions of emotions which alone admit of quantitative determination or measurement by instruments like the psychogalvanometer, they are bound to be misleading to a degree at which all systematic science and scientification must be bidden good-bye. I would rather suggest that the science of psychology should endeavour to vindicate its status notwithstanding the utter unsuitability of the methods of measurement adopted in the physical disciplines, to characteristically psychological data. R. J. Bartlett's Address is an able survey of the entire field of Experimental Psychology, and after all attempts at escaping from one's shadow, trite as it may seem, must be vain. Psychologists need not and should not be apologetic in emphasizing that certain mental phenomena cannot be measured. They should exhibit as they have hitherto done readiness to measure where measurement is possible and practicable.

R. NAGA RAJA SARMA.

* Summary of the Presidential Address by Prof. R. J. Bartlett. Psychology Section—British Association for the Advancement of Science, Dundee, 1939.

Rates and Taxes*

IN his Presidential Address to the British Association for the Advancement of Science, Mr. H. O. Meredith severely criticised our system of rates and taxes and called for a drastic revision of its technique. He began by saying that the most striking feature of our social and economic evolution has been the alarming increase in our public expenditure, as a result of which greater resort would have to be had to private contributions, which though voluntary in the initial stages, will have to be made compulsory if any large-scale all-round development is sought.

Prior to such an increase in public expenditure a thorough investigation into the incidence of taxation is necessary. The end in view should be the avoidance of all random taxation and the minimising of inequality of incomes. All taxation is distasteful and there seems to be an apathy to the study of the burden of taxation. There is an air of glum frivolity about budget discussions. This is attributable to the feeling that State demands are predatory and that regression is the key-note of taxes on low incomes, of local taxes, and of compulsory health and unemployment insurance contributions. Secondly, there is not that clear relationship between the tax-payer and the government which is so very essential. Lastly, public expenditure being costly, the Gladstonian ideal of allowing money "to fructify in the pockets of the people" is upheld. Victorian finance followed the free and easy dictates of *laissez faire* and had the virtue of logical sequence. Presuming that government is necessary for the restraint of evil, internally and externally, it argued that State interference was unnecessary if men behaved rationally and that the real task of statesmanship was the inculcation of right ideas of citizenship into the body politic.

Modern finance differs from Victorian finance in that it is planless, lacking initiative and not spontaneous; our help is more "like a sop to Cerberus than an orderly rationing of food". This planlessness is nowhere more obvious than in the income-tax allowance in respect of children and the system of de-rating. Formerly the relief in respect of a child was 7*s*. 6*d*. per annum—the cost of a dog licence! To-day it is better and the relief is to the value of £16–10–0. Even now, in its actual working there are certain anomalies, in that for the vast majority of small families the relief is disproportionately large while for the really large ones it is surprisingly inadequate; moreover, the relief accorded to the first child was once less than that for succeeding ones and the rate of relief is still not in harmony with the scales of incomes. Turning to de-rating, a similar vagueness is observable. The central problem of local finance should be the choice of purely local sources of revenue; but here the practical difficulty is to differentiate between local and non-local sources and so long as the scheme aims at excluding non-local sources, the Central Government grants could justifiably be increased in accordance with the ever-increasing integration in local and national life. Mr. Meredith criticises the exemption of any part of concrete capital and land, as de-rating then encourages tranfer of investment from those that are rated and that such properties should pay a consolidated rate into a national pool.

Taking the financial system as a whole, he feels that the income, direct and sur-taxes, and death duties are the best. Income surely is the best index of capacity to pay and an inheritance tax has the virtue of reducing inequality. Applying the same tests to local and indirect taxes he concludes that they are highly regressive, have no relation to windfall incomes and tend to aggrevate inequality. Equally true is this of commodity taxes. Mr. Meredith says "as a method of limiting undesirable consumption, taxation is a 'wash-out'. Its effect is to penalise, not to restrain" and refers to the tobacco and liquor taxes as examples. The main force behind such taxation, he adds, is to be found in the desire of the will-to-do to de-tax wealth and to minimise taxation. Mr. Meredith feels that even income-tax needs tightening up since a number of incomes escape taxation. Local taxes have the pernicious effect of not falling on land-values but on retail goods and house-rentals. In fine, he views with scorn all indirect taxes and asserts that all taxes to be paid must be felt, else it would amount to the State picking the pockets of the people. Finally, he does not favour any system wherein a subsistence minimum is exempted. A sufficiently heavy contribution to be felt should be called for from the very bottom of the scale and in this connection the German example is noteworthy. It is a fallacy to base human association upon equity. All such attempts are doomed to failure. Honour, Mr. Meredith emphasises, must compel every citizen to contribute to the upkeep of the State and aptly concludes, "I am convinced that it is psychologically essential, if we desire to build up a democracy, to enshrine this principle in our financial institutions".

B. V. N.

* Summary of the Presidential Address by Prof. H. O. Meredith, Economics Section—British Association for the Advancement of Science, Dundee, 1939.

SCIENCE NOTES AND NEWS

Nobel Prizes, 1939.—The following awards have been announced: *Physics*: Prof. Ernest Orland Lawrence (California University) for his discovery of cyclotrone. *Chemistry*: Prof. Butenandt (University of Berlin), Prof. Ruzicka (University of Zurich) and Prof. Kuhn (Heidelberg University).

* * *

The Thickness of the Liquid-Vapour Interface of Pure Water.—McBain, Bacon and Bruce (*J. Chem. Phys.*, 1939, 7, 818) have described an apparatus for measuring the surface film thickness of less than a monomolecular order of magnitude. The method is based on the optical theory of Drude. The retardation in phase sustained by plane polarised light at a transparent reflecting surface is compensated and measured by tension on a thin microscope glass cover slip. Experiments with pure water give the lower limit of 2–3 Å for the thickness of the interfacial layer at the liquid-vapour interface of pure water. K. S. G. D.

* * *

Upper Air Study in Madras.—An account of average conditions of temperature, pressure and humidity prevailing in the upper atmosphere over Madras, as obtained from measurements extending over a period of four years, is now published (*Memoirs of the Indian Meteorological Dept.*, 1939, 27, Part 2). Being a coastal station, Madras is suited for this kind of work only in the season in which balloons let off from there will be carried westwards by the winds, *viz.*, the months June to November. The study of the upper air climatology of the same latitude in other months is possible only by having an auxiliary inland station, for which Bangalore has been selected and has been functioning, with the co-operation of the Government of Mysore, from last year. The results of Bangalore can be studied with advantage only a few years hence.

Some of the most interesting results obtained from the Madras data are that between the heights of one and ten miles in the upper atmosphere above the earth, the mean temperature over Madras shows every little change from month to month in the period June to November. In October mean temperatures between one and eight miles are practically the same throughout the north-south extent of India, at least along the central strip. In November, from two to eight miles, Poona is warmer than either Agra or Madras.

* * *

Adulteration of Drugs in India.—Tests conducted recently by the *Biochemical Standardisation Laboratory*, Calcutta, on samples of various medicinal preparations of quinine including mixtures, powders, tablets, etc., have shown that nearly *seventy-five* per cent. of the quinine preparations in the Indian market are adulterated. Many of them contain percentages of quinine far below those required to produce any therapeutic effect while some do not contain quinine at all. A number of cases of malaria which have been found to be "quinine resistant" have been reported. While it is certain that there are types of malaria which are resistant to quinine, it is very probable, in view of the findings of the *Biochemical Standardisation Laboratory*, that in many of these cases, the preparations used for treatment contained little or no quinine. Some time back, the *Biochemical Standardisation Laboratory* carried out similar tests on samples of digitalis preparations and found that most of them were far below the strength prescribed by the pharmacopœia. It can be safely asserted that the position is equally bad with regard to other drugs also. The incalculable harm done to the public by adulteration of foods and drugs has been pointed out again and again and the Government of India has been repeatedly urged to introduce effective legislation to prevent adulteration—but so far with very little effect. No Government which has the good of its people at heart can afford to let the present state of things to go on. The work on quinine preparations done by the *Biochemical Standardisation Laboratory* is only one more proof (if any proof were needed) of the urgent necessity for taking immediate measures to prevent adulteration of foods and drugs in India.

* * *

Mineral Production in India.—The total value of ores, minerals and metals produced in India during 1938 is estimated by the Geological Survey of India at about Rs. 34,13,95,000 or £25,477,000 as against Rs. 30,49,43,000 or £22,928,000 in 1937. This represents an increase of nearly 12 per cent. and is largely due to the record production of coal—28,343,000 tons valued at Rs. 10,64,24,000 or £7,942,000 which exceeds the production of the previous year by over 35 per cent.

Of the other minerals, ores and metals, the production of steel has gone up slightly; pig iron production is also better, but with the fall in price there has been a decline in the production of manganese. Gold output is steady, petroleum has improved and so have building materials and salt, but mica has fallen appreciably and so has copper. Ferro-manganese has more than doubled in value, while in ilmenite, with increasing production, India is leading. Chromite has fallen in value, but monazite, gypsum and steatite have improved. Diamonds, graphite and felspar have improved as against barytes, bauxite, asbestos and tungsten-ore which have declined in value. In bauxite the fall in value is entirely due to the fall in price and nct to any fall in quantity. The total values of apatite, beryl, garnet and sapphire production have all fallen greatly.

Occurrence is reported of antimony-ore (zinckenite) in Chitral; explorations are being continued for the discovery of tungsten-ore.

* * *

Eradication of Kans.—The Imperial Council of Agricultural Research have sanctioned a two-year scheme of research for studying *Kans*, a noxious weed ruining thousands of acres of cultivated land in Central India, Bundelkhand and Central Provinces.

Once the weed gets established, especially in black cotton soils, there is no end to the damage. The cultivator is unable to plough it out with the ordinary plough. The weed spreads with ferocious rapidity.

The Bhopal Government purchased two of the heaviest agricultural tractors available in India at a cost of about Rs. 50,000 and spent an additional sum of Rs. 75,000 in ploughing *Kans* infested land to a depth of 10–12 inches. This method brought many a field under cultivation but it could not be regarded as a permanent solution of the problem.

At present scientific information on the life-cycle and root-system of the weed does not exist. Methods adopted in Central Provinces and Indore were found by the Bhopal Director of Agriculture to be helpful to a limited extent in bringing the weed under control but not in eradicating it. He also found that Mr. (now Sir) A. Howard and the late Mrs. Howard's method was too expensive for the cultivator.

In the working of the scheme, the Advisory Board has suggested that a study should be made of the work done on the subject in Central Provinces, Bombay and Indore.

* * *

Recent Work at Rice Research Stations.—On account of the amazing diversity of soil and climate in India, the number of varieties of rice is immense, and the methods of cultivation vary considerably. At one end of the scale, there is deep water paddy such as grows in parts of Assam where the rice stem elongates as the flood water rises and may attain a length of eight feet. At the other, we have in Baroda and parts of Gujerat, rice grown purely as a rain-fed crop without any flooding and sometimes along with and in the same field as cotton. Obviously no single central station can tackle all the problems connected with rice.

The problem of producing suitable rices for export has been investigated at some places. In Bengal several crosses have been made to evolve high-yielding strains of rice conforming to the requirements of the export trade for Britain. A hybrid strain has been evolved which is close to the *American Blue Rose* in size and texture. An improved strain *Gosaba* 23 is distributed in the regions where the quality of *Patnai* rice, a favourite export strain, is found deteriorating.

In addition to the obtaining of varieties with higher yields, plant-breeding work has been successful in providing strains which resist certain pests and diseases. The problem of saving the early rice crop in the United Provinces from the rice fly, *gundhi*, which by sucking the grain destroys the crop over extensive areas, has been handled by crossing prolific grained strains with a coarse grained and early poor yielding type known as *Sathi* which by virtue of a leaf covering the ear-head escapes the attacks. Hybrid strains immune to the fly have now been bred. They are superior to *Sathi* in yield and fineness of grain and earlier than the types under distribution.

In certain rice areas self-sown wild rice is a nuisance. To enable it to be recognised and pulled out at an early stage in the Central Provinces, strains have been evolved as a result of hybridisation, which are more prolific in yield and can be distinguished from wild rice by a distinctive colour in the early stages. The seeds of these hybrids have been distributed and have met with success.

To criticise programmes, to study results and to help in deciding policy, there is a standing Rice Committee of the *Imperial Council of Agricultural Research*, on which all interests are represented. The Committee not only co-ordinates research, but also makes sure that research is adapted to the needs of the cultivator and the trade.

* * *

Vegetable Insecticides.—The Industrial Section of the *Indian Museum, Calcutta* (Botanical Survey of India) has recently acquired and placed on show specimens of *Derris root*, commercially known as Tuba root, and flowers and plants of Pyrethrum. The *Derris root* and Pyrethrum flowers are considered to be essential ingredients in insecticidal preparations used as dust or spray.

The *Derris roots* have been obtained from Assam, Bangalore and the Central Experimental Station at Serdang in the Federated Malay States, and the Pyrethrum plants and flowers from Kashmir and the Murree Hills of the Punjab. Some Pyrethrum flowers have also been received from Harpenden in the United Kingdom and Kenya. To make the exhibits attractive, pictures of the plant specimens drawn in their natural colours have been placed by their side.

More efficacious and less costly to produce, there has been in recent years a growing world demand for insecticides of vegetable origin, which are comparatively harmless to human beings, to replace more dangerous arsenical and other chemical preparations.

Insecticidal preparations from Derris have been tried with success in Assam against biting and sucking insects and in Madras against caterpillars which damage the cabbage crops. In Bengal, too, a preparation has been tried as spray against mango leaf hopper and found efficacious, but the cost is reported to be high.

Attempts are being made to cultivate "Tuba" in several parts of India; the plant grown in Mysore, in particular, has been found to give a good yield of rotenone, the active principle on which depends the value of these products as insecticides.

* * *

Electro-Magnetic Grain Cleaner.—The electro-magnetic seed cleaning is based on the observation that many wild seeds, particles of stubble and broken grain have a rougher surface as compared to that of good seeds. When the seeds are mixed with fine iron powder, the iron adheres to the rough surface and can be separated away from smooth-surfaced good grains by passing over magnetic cylinders. In

actual practice, steel dust is employed and a small quantity of liquid medium, either water or a mixture of castor and olive oils, is used to increase the adherence of the powder to the rough surface of the useless material.

* * *

Biological Control in the Lac Industry.—Lac insects are subject to the attack of two classes of enemies, internal parasites and external parasites and external predators, whose control is a factor of major importance in the commercial production of lac. The practicability of biological control of these enemies is discussed in a paper by Glover and Gupta in a contribution published by them in a recent number of the *Indian Journal of Agricultural Science* (1939, 19, 523). According to these authors, predators constitute the more destructive agents affecting about 30–40 per cent. of lac cells. The emphatic statement that the damage done by parasites is small (4·8 per cent.) may be questioned by other experienced workers in the field, whose work as is customary with these authors, has been ignored. They refer to the "recently discovered egg parasites of lac predators" the practical demonstration of whose effectiveness will be awaited with keen interest.

* * *

Indian Central Cotton Committee.—The *Annual Report* for the year ending 31st May 1939, which we have just received, provides an impressive record of service rendered to the Indian Cotton Industry. The spinning value of 635 samples of new cottons has been determined thus providing the various provincial agricultural departments, as well as others, with complete and authoritative reports on the spinning value of their products. Many samples of yarn, cloth and cotton were received for fibre tests as also some samples for moisture tests and dye absorption tests. In addition, tests on trade samples, samples from cotton mills and Indian standard cottons were carried out. Many of these tests are of a routine nature, such as the determination of tensile strength of cloth or yarn, determination of actual counts, number of turns per inch, reed and pick, etc., but some of the interesting features met with in the course of testing these samples are mentioned in the Report.

Several technological tests such as the effect of fibre weight on spinning quality of Indian cottons, effects of storage on the quality of Indian cottons, have been carried out and reported during the period under review, in the form of technological bulletins and circulars. For the interested public, two small brochures have also been issued from the Laboratory.

Summaries of technological bulletins as also a list of tests which may be carried out for the trade on payments are found in the Report.

It is gratifying that in about two years time, the number of samples received has increased by 50 per cent.; but the total number of samples received is not commensurate with the large volume of the industry. It is to be hoped that in the coming years, the cotton mills and firms will take greater and greater advantage of the facilities offered by this official testing house of the Indian Textile Industry. P. S. S.

The League of Nations' World Economic Survey, 1938/39 (Ser. L.o.N. P., 1939, II A. 247 pages) was completed on the eve of the outbreak of hostilities in Europe. According to a communique issued by the Information Section, it covers events up to beginning of August 1939, and thus presents a picture of the world economic situation up to the date of the beginning of hostilities. During the first months of 1939 the world was making a rapid recovery from the major depression with which it had been threatened in the first half of 1938. This rapid reversal of economic conditions may be ascribed in part to financial measures taken in the United States of America and in other countries in order to stimulate the lagging demand for goods and services. But in the main it was due to increased expenditure on armaments and war preparations.

This issue—the eighth in the series—includes a number of special studies. One chapter, for example, is devoted to a study of the economic effects of recent changes in the trends of population.

A second chapter studies the problems of public finance, and examines the extent to which the costs of rearmament have eaten into the national incomes of various countries.

The concluding chapter, entitled "The Economic Effects of War, Rearmament and Territorial Changes" summarises the main theme of the volume. Economic destruction in Spain and China and the reduction in the standard of living in Japan as a result of war; the economic effects of the territorial expansion of Germany; and the greatly increased intervention of the State in economic affairs for the purposes of national defence;—these are the main subjects of the chapter. In various other chapters the growing importance of political tension and of rearmament is emphasised in their effects on economic activity, on world trade, on hours of work and the demand for labour, on budgetary and monetary policies, and on commercial relations between the nations.

* * *

Business Cycles in the United States of America, 1919-1932.—The Economic Intelligence Service of the *League of Nations* has just published the second volume of the series "Statistical Testing of Business-cycle Theories" dealing with the business cycle in the United States of America from 1919 to 1932. According to a communique from the Information Section of the *League of Nations*, this volume applies the system of mathematical analysis described in the first volume to the post-War trade data of the United States. It aims at determining on the basis of existing statistics and with the help of the "multiple correlation method," the more important quantitative relationships which have governed the economic system of the United States of America during the period under review. In this way, some forty equations are found, which are thought to represent the main characteristics of the mechanism of the United States business cycles in that period. The combination of these equations by mathematical treatment ("elimination process") yields one "final" equation, from which

emerges the general nature of the United States cycle (*cf. Curr. Sci.*, 1939, 8, 192).

* * *

Scientific Expedition to Central Pacific.—The expedition sponsored by the *National Geographic Society and the University of Virginia with the U.S. Coast Guard co-operating* (*cf.* this *Journal*, 1939, 8, 391, 493), has been indefinitely postponed, owing to the outbreak of war in Europe. According to a communique issued by the *National Geographic Society*, the expedition was to have sailed from San Francisco on September 19 on the Coast Guard cutter *Hamilton*, but plans had to be shelved when the *Hamilton* was ordered to Atlantic waters as part of the coast patrol established by President Roosevelt to preserve American neutrality.

Tons of scientific equipment had been shipped to the Pacific Coast to be loaded on the *Hamilton*, and scientist members of the expedition had spent months of intensive work preparing apparatus for studying geology, magnetism of the earth, variations in gravity, earthquakes, marine biology, weather, ocean currents, and for collecting samples of the ocean bottom from great depths. The expedition was to have conducted the most extensive programme of scientific work ever attempted in the Pacific Islands region.

Most of the expedition's apparatus now is being shipped back to scientific laboratories, universities, and government agencies which supplied it. Some of the supplies will be stored for future use when the expedition can proceed, and perishable materials will be sold.

Prof. Wilbur A. Nelson, leader of the expedition, will return to his duties as Professor of Geology at the University of Virginia to await conditions better suited to scientific research on the high seas.

* * *

A Phytogeographic Map for India.—At the ordinary meeting of the *Royal Asiatic Society of Bengal* held on Monday, 6th November, Dr. D. Chatterjee presented a paper on his studies relating to the endemic flora of India and Burma. The author has traced the relationships of the various groups of Indian plants with those of the surrounding countries, and also discussed the nature of invasion of foreign plants into India. The author states, "In a continental area, it is unusual to find a high degree of endemism but 61·5 per cent. of Indian plants has been found to be endemic. A possible explanation based mainly on the theory of isolation has been put forward in the present case. The endemic species have been found in high concentration in three regions: (*a*) The Himalayas, (*b*) South India, and (*c*) Burma".

* * *

The following students of the **Imperial Agricultural Research Institute, New Delhi,** have been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after the completion in 1939 of their two-year post-graduate courses and the acceptance by the Institute Council of theses submitted by them in the subjects noted against each:—

(1) Atamaram Bhairav Joshi (Botany); (2) G. Suryanarayana Murti (Botany); (3) Ram Mohan Arora (Botany); (4) Sham Lall Juneja (Botany); (5) W. V. B. Sundara Rao (Agricultural Chemistry); (6) Abhiswar Sinha (Agricultural Chemistry); (7) Atam Prakash Kapur (Entomology); (8) Raghubir Sahai Mathur (Mycology); and (9) S. Y. Padmanabhan (Mycology).

* * *

National Institute of Sciences of India.—The following gentlemen have been elected Fellows of the Institute:—*Ordinary Fellows*: (1) Dr. K. Banerjee, D.Sc., Reader in Physics, Dacca University. (2) Prof. F. R. Bharucha, B.A., B.Sc., D.Sc., Professor and Head of the Department of Botany, Royal Institute of Science, Bombay. (3) Dr. R. N. Ghosh, D.Sc., Reader in Physics, Allahabad University. (4) Prof. H. K. Mookerjee, D.Sc., D.I.C., University Professor and Head of the Department of Zoology, Calcutta University. (5) Prof. V. V. Narlikar, B.Sc. (Bom.), B.A. (Cantab.), F.R.A.S., Professor and Head of the Department of Mathematics, Benares Hindu University. (6) Dr. C. G. Pandit, M.B.B.S., Ph.D., D.P.H., D.T.M., Offg. Director, King Institute of Preventive Medicine, Guindy, Madras. (7) Major C. L. Parischa, I.M.S., Professor of Pathology and Bactericlogy, School of Tropical Medicine, Calcutta. (8) Prof. L. Rama Rao, M.A., F.G.S., Professor of Geology, Mysore University. (9) Dr. M. Shariff, D.Sc., Ph.D., Entomologist, Haffkine Institute, Bombay. (10) Dr. K. Venkataraman, M.Sc., (Tech.), Ph.D., D.Sc., Director, Bombay University Laboratories of Chemical Technology and Textile Chemistry.

Honorary Fellows: (1) Dr. E. V. Appleton, M.A., D.Sc., F.R.S., Secretary, Department of Scientific and Industrial Research of Great Britain. (2) Prof. Charles W. Edmunds, A.B., M.D., Professor of Pharmacology and Therapeutics, University of Michigan Medical School, U.S.A. (3) Prof. R. A. Fisher, Sc.D., F.R.S., Galton Professor in the University of London. (4) Prof. Waldemar Lindgren, Emeritus Professor of Geology, Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

* * *

Herbert Akroyd Stuart Award, 1937-39.—Information has been received at Calcutta that Mr. S. N. Mukerji, M.Sc., A.M.I.E. (Ind.), a member of the Research Staff, *Government Test House, Alipore*, has been awarded the prize of £50 under the above award for his paper on "The Origin and Development of Heavy-Oil Engines". The award is provided under the will of the late Herbert Akroyd Stuart, a pioneer in the development of oil engines, bequeathed to the *Institute of Marine Engineers*, London, for the best paper by a member or non-member on the subject above referred to. The award is given every two years. The Awards Committee reported that the 'entries received on this occasion were of a very high standard of merit', and they have specially complimented Mr. Mukerji on his excellent essay. Owing to the difficulty of distance the requirement that the winning paper shall be read at a meeting of the Institute has been waived and the paper will be published in the November issue of the Institute's *Transactions*.

* * *

University of Mysore.—I. GENERAL: The Senate, the Academic Council and the University Council were reconstituted for a period of three years (1939–42). II. CONVOCATION: The Twenty-second Annual Convocation for conferring degrees was held on the 25th October 1939, His Highness the Chancellor presiding. Sir Nripendranath Sirkar, K.C.S.I., delivered the Convocation Address. III. MEETING OF THE ACADEMIC COUNCIL: The first ordinary meeting of the Academic Council was held on 8th September 1939. The propositions that were passed at the meeting of the Academic Council held on the 8th September 1939 included—one relating to the institution of course of study in Chemical Engineering, and another relating to the institution of French and Latin as second languages which may be offered at a University Examination provided satisfactory arrangement for instruction is made by the candidates themselves. IV. LECTURES: The Sri Krishnarajendra Silver Jubilee Lecture of a previous year was delivered by Sir T. Vijayaraghavacharya, K.B.E., at Bangalore on the 1st September and that for the current year by Sir Alladi Krishnaswami Aiyar on 30th September 1939, the subjects being "Scientific Research in Agriculture" and "Law as an Instrument and Measure of Social Progress" respectively. V. EXAMINATION: The results of the L.M.P. Examinations held in October 1939 were published. They were as follows:—

	Number Examined	Passed
First L.M.P.	.. 14	7
Second L.M.P.	.. 25	14
Third L.M.P.	.. 40	19
Final L.M.P.	.. 43	18

Announcements

The 11th Session of the **Indian Mathematical Conference** will be held at Hyderabad under the auspices of the Osmania University from 21st to 23rd December 1939. Apart from the reading of papers, two Symposia will be held on (1) "Generalised Geometry, including Relativity and Field Theory", and on (2) "Warring's Problem". A discussion on the Teaching of Mathematics in Schools and Colleges will also be held. Three public lectures will be delivered, the subjects being (1) Meteoric Astronomy; (2) Mathematical Recreations; and (3) Mathematics, the Handmaid of Arts, Science and Economics.

Excursions, specially to the famous Ellora and Ajanta Caves, are also being arranged.

Those who wish to attend the Conference can communicate with the Local Secretary, Department of Mathematics, Osmania University, Lalaguda, Hyderabad (Deccan).

All-India Sugar Conference.—The Government of India have decided to convene an All-India Sugar Conference representing all interests, at an early date. It will consider measures for the rationalisation and stabilisation of the sugar industry.

Items such as the regulation of cane production, payment of premium for special varieties of cane, legislation for zoning, licensing of factories, establishment of industries subsidiary to sugar and of a central marketing organisation, etc., have been recommended by the Sugar Committee and the Advisory Board of the *Imperial Council of Agricultural Research.* These items will be referred to the proposed All-India Sugar Conference.

Science Progress.—The Editors and Publishers (Messrs. Edward Arnold & Co.) of this well-known quarterly review, founded by Sir Ronald Ross in 1907, announce with regret that the October number will be the last to appear for the present. The purpose of the review is to record recent advances in pure science and to publish articles by those who have played a leading part in such work. Research of this kind is bound to be seriously diminished in war-time, and therefore it has been reluctantly decided to suspend publication until conditions are more favourable.

An article by Sir Arthur Eddington on "The Cosmological Controversy" is a notable feature of the October number.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, No. 3.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 5.

"The Philippine Agriculturist," Vol. 28, No. 5.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 9.

"L'Agricultura Coloniale," Vol. 33, No. 7.

"Biochemical Journal," Vol. 33, No. 8.

"Contributions from Boyce Thompson Institute," Vol. 10, No. 4.

"Journal of Chemical Physics," Vol. 7, No. 9.

"Comptes Rendus," (DOKLADY), Vol. 24, Nos. 3–4.

"Experiment Station Record," Vol. 81, No. 3.

"Indian Forester," Vol. 65, No. 11.

"Forschungen und Fortschritte," Vol. 15, No. 23/24.

"Genetics," Vol. 24, No. 5.

"Review of Applied Mycology," Vol. 18, No. 9.

"Calcutta Medical Journal," Vol. 36, No. 4.

"The Mathematics Student," Vol. 7, No. 2.

"The Bulletin of the American Meteorological Society," Vol. 20, No. 7.

"Journal of the Indian Mathematical Society," Vol. 3, No. 7.

"Indian Medical Gazette," Vol. 74, No. 10.

"Nature," Vol. 145, No. 3646.

"American Museum of Natural History," Vol. 44, No. 2.

"Proceedings, Royal Netherlands Academy," Amsterdam, Vol. 42, No. 6.

"Indian Journal of Physics," Vol. 13, No. 4.

"Sky," Vol. 3, No. 11.

"Indian Trade Journal," Vol. 135, Nos. 1738, 1740–41.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 9, Pt. III.

ACADEMIES AND SOCIETIES

National Institute of Sciences of India, Calcutta:

August 25–26, 1939.—R. R. BAJPAI AND K. B. MATHUR: *Absorption of electromagnetic waves in the earth's atmosphere.* B. N. SRIVASTAVA: *Heat of ionic dissociation of the chloride and bromide of rubidium.* K. B. MATHUR: *Absorption and reflection of radio waves of oblique incidence and their relationship with vertical incidence phenomena.* M. ISHAQ: *The extension of the (O, O) band of OD.*

SYMPOSIUM ON COAL IN INDIA

E. R. GEE: *History of the development of the coal industry; The history of coal-mining in India; The geology of Indian coal.* M. S. KRISHNAN: *India's coal reserves; India's position in the world as a coal producer; Conservation of coal.* CYRIL S. FOX: *Coal in relation to metallurgical operations; Coal in relation to power.* B. WILSON HAIGH: *Carbonisation of coal and recovery of by-products.* W. J. SAVAGE: *Carbonisation of coal.* S. K. ROY AND S. S. GHOSH: *Fuel oil from inferior Jharia coals.* C. FORRESTER: *Briquetting of coal in India.* A. N. MUKHERJEE: *Briquetting of coal.* CYRIL S. FOX: *The underground gasification of coal.* N. N. CHATTERJEE: *Domestic coke.* C. FORRESTER: *Domestic coke.* N. N. CHATTERJEE: *Fuel research.* C. FORRESTER: *Fuel research in India.* CYRIL S. FOX: *Fuel research: Indian coal.* H. K. NAG: *Safety in mines through education.* E. B. PARK: *Safety in coal mining.* R. P. SINHA: *Safety in coal mining.* L. J. BARRACLOUGH: *Packing with incombustible material in coal mines.* W. KIRBY: *Some physical conditions which affect spontaneous heating in coal mines.* E. B. PARK: *Fires and ignition in mines.* C. FORRESTER: *Storage of coal.* E. R. GEE: *Storage of coal.* C. A. INNES: *Indian export trade in coal; The marketing of coal in India.* A. L. OJHA: *Some problems of Indian coal.* N. N. CHATTERJEE: *Chemical constitution of coal; Methods of analysis of coal.* C. FORRESTER: *Methods of analysis of coal in India.* J. SANJANA: *Sampling of coal.* C. FORRESTER: *Coal cleaning and benefication in India.* E. R. GEE: *Coal cleaning and benefication.* N. N. CHATTERJEE: *Sulphur in coal.* E. R. GEE: *Moisture in coal.* J. S. SANJANA: *Moisture in coal.* R. K. DUTTA ROY: *A critical study of some Indian coal ashes.* J. S. SANJANA: *Ash in coal.* C. FORRESTER: *Volatile matter in coal.* M. S. KRISHNAN: *Classification of coal.* N. N. CHATTERJEE: *Micro-structure of some Indian fusains.* S. K. ROY: *Microscopic determination of the Barakar and Raniganj sandstones of the Jharia coalfield.* C. MAHADEVAN: *Studies in coal by X-ray diffraction methods.* R. K. DUTTA ROY: *Studies on the action of solvents on Indian coal.* B. SAHNI: *The Palæobotanical correlation of coal seams in India.* M. S. KRISHNAN: *State control in the coal industry.* D. D. THACKER: *The present status of the coal industry.*

Indian Academy of Sciences:

October 1939. SECTION A.—H. J. BHABHA, H. CARMICHAEL AND C. N. CHOU: *Production of bursts and the spin of the meson.* S. BHAGAVANTAM: *On the occurrence of overtone lines in Raman effect.*—It should be quite possible to record the overtone of the hydrogen frequency at approximately double the normal Raman shift as its intensity is expected to be only 1/155 of that of the fundamental. V. R. THIRUVENKATA CHAR: *Note on some formulæ involving the Laguerre and Hermitian polynomials and Bessel functions.* S. RAMACHANDRA RAO AND S. R. GOVINDARAJAN: *The crystal diamagnetism of tellurium.*—The principal susceptibilities are found to be $-0{\cdot}329$ parallel to the trigonal axis and $-0{\cdot}296$ perpendicular to same, leading to 1·11 for magnetic anisotropy. Influence of temperature and small admixtures of other elements have been studied. K. BAPAYYA: *A study of the continuous wings occurring in Raman effect.*—Besides the optical anisotropy, other physical properties of the liquid, such as its viscosity and dipole association play a prominent part in determining the intensity of the wings. W. BUKHSH AND R. D. DESAI: *Heterocyclic compounds—Part X. The synthesis of substituted* 1 : 2 : 3 : 4-*tetrahydroacridones.* P. SURYAPRAKASA RAO, V. D. NAGESWARA SASTRI AND T. R. SESHADRI: *Geometrical inversion in the acids derived from the coumarins—Part VII. The behaviour of acetyl coumaric acids.* D. N. MOGHE: *On isotropic manifolds in the theory of relativity.* R. K. MEHRA AND K. C. PANDYA: *The condensation of aldehydes with amides—Part IV. Of* m-*hydroxybenzaldehyde.* M. MANZUR AND K. C. PANDYA: *The condensation of aldehydes with amides—Part V. Of* p-*hydroxybenzaldehyde.* R. K. MEHRA AND K. C. PANDYA: *The condensation of aldehydes with amides—Part VI. The condensations of* o-, m- *and* p-*methoxybenzaldehydes.* K. SUBBARAMAIAH: *Studies in colloid optics—III. Scattering of light by stearic acid hydrosols and by sodium stearate sols and gels.*—The micelles in stearic acid sol are appreciably large and increase continuously on heating due probably to partial coagulation by heat. The asymmetry in shape of micelles diminishes with rise in temperature. A. MOESSNER: *Einige numerische Identitäten.* G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and chemical constitution. Influence of constitutive and other factors on the double* bonds in organic compounds.—Part II. *Effect of the phenyl group on the carbonyl bond in esters.* —The phenyl group attached directly to the carbon of the C = O group as in esters of aromatic acids and in aromatic ketones, etc., markedly lowers the carboxyl frequency whereas the same group attached to the C = O through an oxygen atom as in phenyl esters markedly enhances the frequency.

October 1939. SECTION B.—G. N. RANGASWAMI AYYANGAR AND B. W. X. PONNAIYA: *Studies in* Sorghum sudanense, *Stapf.—The Sudan Grass.* G. W. CHIPLONKER: *Lemellibranchs from the Bagh Beds.* MANOHAR LAL MISRA: *On some stone implements from Hoshangabad (Central Provinces).*

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Organisation of Industrial Research

DURING the last week there have been two notable pronouncements from the public platform, both of which have a close bearing on the question of India's industrial future. Sir Mirza M. Ismail, Dewan of Mysore, in welcoming the delegates to the eleventh session of the *All-India Industries' Conference*, which met at Mysore on the 15th of this month, referred to the "fitful" and "fragmentary" character of our attempts to deal with the problem: "There has been no sustained and continuous visualisation of India's economic life in its several aspects into a self-consistent whole. Proposals like those of the Indian Economy Enquiry Committee for a comprehensive statistical organisation and of Sir Arthur Salter for an Economic General Staff, have been allowed to disappear into oblivion. On the other hand, specific fields have been surveyed with thoroughness by various Committees and Commissions, *i.e.*, Industries, Currency and Banking, Railways, Agriculture, but no effort has been made to examine the implications of the results of the surveys in their general economic setting."

In his welcome address to the fifteenth annual session of the *Inter-University Board*, which took place at Waltair on the same day, Dr. C. R. Reddi, Vice-Chancellor, Andhra University, spoke on the place of Universities in the war economies of a nation. He referred to the situation which arose 25 years ago and pointed out how the European countries and America grasped

the opportunity to achieve a state of self-sufficiency. "By confiscating enemy patents, by vigorously promoting domestic industries in regard to dyes, drugs, etc., and utilising Universities for purposes of the necessary researches, European countries and America became self-sufficing." The results of their efforts, can be judged by their present economic position, which is both permanent and enduring.

During the Great War, the Government of India appointed the Indian Industrial Commission, "to examine and report upon the possibilities of further industrial development in India and to submit its recommendations". The Indian Munitions Board which was the immediate outcome of its labours was constituted in January, 1917; some efforts to develop the national resources were made, but soon after the termination of the hostilities, little was heard of the Munitions Board, which might well have been constituted into a permanent body for promoting the development of industries in this country, as envisaged by the Commission.

Since the last War, a few institutions for the development of primary industries have been established in this country, thanks to the expanding activities of the Imperial Council of Agricultural Research; the Lac Research Institute at Ranchi; the Indian Central Cotton Committee at Bombay and the Indian Central Jute Committee at Calcutta, are typical instances. But these at the moment have done little for the establishment and stabilisation of the consuming industries in this country. The researches on the utilisation of lac, are being pursued more actively at the London Shellac Research Bureau at the consumers' door than in India. In other words, these institutions have yet to play their part in helping the promotion of industries in India itself.

The Universities in India have fairly well-equipped laboratories and workshops; there are institutions like the Indian Institute of Science which provide facilities for industrial research; while a number of well-trained and competent men to tackle industrial problems, are available. What is needed, however, is a mechanism by which all the resources could be brought together under one directive authority for advancing industrial research.

The Indian Industrial Commission (1916) drew attention to the deplorable lack of organisation in the scientific services. They found that scientific experts formed themselves into heterogeneous groups with no uniform conditions of service, no definitely established policies or precise limits of their activities. They also discovered a complete absence of effort to secure collaboration in scientific research. This disorganisation had involved a considerable waste of money, time and talent, by duplication of equipment and effort. Even to-day, the conditions are not different. There is considerable overlapping of research work on some subjects and total neglect of others. There is no authoritative organisation for assessing the value of results on any particular investigation and a disconcerting variety of isolated and short-lived serial publications frequently make their appearance.

It is, perhaps, pertinent to recall that early in 1915 the British Government, in spite of the pre-occupations and distractions of a terrible war constituted the Department of Scientific and Industrial Research in order to ensure a systematic application of research

for organising her economic resources. Later, special research organisations, controlled and financed by this Department, were inaugurated to deal with the scientific aspects of the use of fuel, the storage and transport of food, buildings and roads—subjects of great importance to the common welfare of the community. The industries began to appreciate the importance of scientific research for their advancement and prosperity and it became possible for the Government to institute a number of co-operative research associations, autonomous and controlled by representatives of the industries concerned and financed by the funds of the Association supplemented by grants by the Department. The establishment of a Department of Scientific and Industrial Research in Great Britain, was soon followed by the institution of similar organisations in other parts of the Empire; Canada had its National Research Council in 1916, while Australia formed its Council of Scientific and Industrial Research in 1926. The United States of America founded its National Research Council in 1916, while Japan established its National Institution in 1919. India needs an organisation modelled on very much the same lines as the Department of Scientific and Industrial Research of Great Britain and the Government of India is the only authoritative body who should take the initiative in this matter.

Sir A. Ramaswami Mudaliar, Commerce Member to the Government of India, mentioned at the recent Industries Conference that the Government could give the commercial community an indication of the kind of industries that might safely be developed during the war and of the nature of assistance they could extend to such industries. He also said that the Government would indicate beforehand, the nature of the aid which the industries may expect after the cessation of the war. Businessmen who launch upon new enterprises, taking advantage of the abnormal conditions created by the war, must be assured of some sort of protection after the termination of the conflict. An immediate declaration of such a policy by the Government at this stage would stimulate private enterprise in the field of Indian industry. The appointment of a committee to investigate the production of drugs and the proposal regarding the Government of India Statistics Act for allocating and collecting industrial statistics to enable the Government to have adequate information about industrial progress, were announced at the Conference. These announcements are reassuring and they will undoubtedly contribute to the development of industries in this country. What is even more vital to the industrial development of India is a national organisation for industrial and scientific research for developing the vast resources of this country. The labours of numerous committees in the past have resulted in the accumulation of valuable data regarding India's industrial potentialities and the time is opportune for establishing an organisation—a National Research Council—under the auspices of the Government of India for planning and directing Industrial Research on an all-India basis.

Prof. E. O. Lawrence

ERNEST ORLANDO LAWRENCE, who has won the signal distinction of a Nobel Prize for Physics for 1939, began his research career at the University of Chicago in the year 1924, under Professor Swann, on the photo-electric effect in potassium vapour as a function of the frequency of light. With Professor Swann, Lawrence moved to the University of Yale where he completed these investigations which formed the subject of a dissertation for his PH.D. degree. In 1928 Lawrence migrated to the University of California at Berkeley and there he is now continuing his investigations which have brought him fame and the approbation of the scientific world. Much of Lawrence's earlier work was concerned with studies of photo-electric phenomena. It was in 1931 that Lawrence began to tackle the problem of production of high speed ions.[1] R. Wideroe had by then suggested an apparently simple method of producing high voltage ions using only relatively low applied voltages,[2] and had himself succeeded in obtaining 50,000^{v} potassium ions in a tube to which a maximum voltage of half that value had been applied. Lawrence took up the idea and improved upon it with perseverence and ingenuity.

The principle of the method of Wideroe as at first developed by Lawrence is as follows: A series of cylindrical electrodes arranged along the length of an evacuated tube are attached alternately to either terminal of the inductance of a high frequency oscillatory circuit. A high frequency voltage applied in this manner, produces at any instant, electric fields of opposite direction and equal magnitude between successive electrodes. If at any one instant an ion finds itself between the first and second tubes it will be accelerated into the second tube, and if the time consumed in passing through the field-free space inside this tube is equal to the half period of the oscillator, the ion will arrive between the second and third tubes, with the field reversed in direction in such a manner that it will receive an additional acceleration while passing into the third tube. If the tubes are made successively longer to take account of the increasing velocity of the ion, for every frequency of applied oscillations there will be a corresponding voltage applied such as will cause the ion to move up through the series of tubes in synchronism with the oscillating field, gaining between each pair of tubes an increase in kinetic energy corresponding to the applied potential difference. Sloan and Lawrence[3] showed that by the above method they could produce mercury ions of 1,260,000 volts using 30 accelerator brass tubes and a high frequency voltage of 42,000 on a wave-length of 30 meters.

The difficulty with the above type of apparatus is that the lengths of the accelerator tubes used towards the end of the path become very large even for heavy ions like Hg ion and the whole apparatus becomes inordinately long. To overcome this difficulty Lawrence conceived the idea of bending the path of the ions into circular orbits by a magnetic field and thus the first "cyclotron" was born.[4] In this device the electrodes in the form of semicircular hollow brass plates are mounted with their diametral edges adjacent in a vacuum and in a uniform magnetic field perpendicular to the plane of the plates. An oscillating electric field is produced by high frequency oscillations applied to the electrodes in the diametral region where ions are accelerated. They then describe semi-circles inside the electrodes, the time taken being arranged to be a half period of the oscillations. When they re-emerge into the diametral region they are again accelerated and then describe second semi-circles. Repetition of this process gives the ions very high velocities. The focussing action of the electric and magnetic fields gives narrow intense beams. Using a magnet with pole faces 11 inches diameter a narrow beam of current of 10^{-9} amperes consisting of protons of $1{\cdot}22 \times 10^{6}$ volts velocity has been obtained from a maximum applied voltage of 4,000.

In 1934, Lawrence and Livingston[5] constructed an improved and larger apparatus of the above type, and attained a maximum speed of the hydrogen atoms corresponding to 5,000,000 electron volts the ionic current being 1/3 microampere.

Lawrence and Cooksey have recently[6] described their latest cyclotron called also "magnetic resonance accelerator". The pole faces of the magnet are 3½" apart and have a diameter of 27½" although the actual effective diameter of the pole faces is 42". The atomic beams can be led out into the air through thin platinum windows

and their range amounts to several centimeters in air. A still larger cyclotron is now in the making.[7]

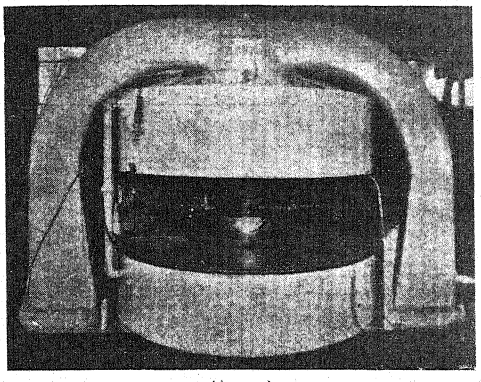

FIG. 1
The cyclotron of Prof. Lawrence. The window through which the high-speed atoms emerge out into the air is marked by the arrow-head

When high speed deuteron streams are made to fall on berylium atoms, streams of neutrons are produced so powerful in their biological action that they are equivalent to the gamma radiations from 100 grams of radium. Accordingly, for the protection of the operator, the cyclotron is controlled from a distance of 40 feet from the apparatus with suitable intervening absorbing materials. With the deuteron streams, Lawrence has produced radioactive isotopes of many of the different elements known in the periodic table. In many cases the yields of the radio-active substances are quite large; as for example, a day's bombardment of sodium metal with 20 microamperes of 5 million volts deuterons produces more than 200 milligrams equivalent of radio-sodium, *i.e.*, an amount of radio-sodium having a γ-ray activity equivalent to that of 200 milligrams of radium. That such large amounts of radio-active forms of many of the elements can be manufactured in the laboratory is of immense importance in opening up new avenues of research both in the physical and in the biological sciences. Many striking results have been obtained by Lawrence himself and his co-workers, while of course, similar work on nuclear transformations is being carried out in different physical laboratories of the world by other methods as well. But the cyclotron holds a unique position in that it can provide very large yields and possesses potentialities of even greater developments which stagger the imagination of the world.

Most of Lawrence's researches were encouraged by substantial public support. *The Federal Telegraph Company* donated the steel castings of the magnet. *The Research Corporation* and the *Chemical Foundation* provided funds for the construction and installation of the magnet and accessory apparatus, while the operating expenses were met by the *University Research Board*. But above all it was the genius and the single-minded devotion of Prof. Lawrence that overcame all the practical difficulties and brought to a very successful fruition an idea that must well nigh have looked fantastic when it was originally conceived; no wonder, the world applauds.

B. DASANNACHARYA.

Benares Hindu University,
November 20, 1939.

[1] Lawrence and Swann, *Proc. Nat. Acad. Sci.*, 1931, **17**, 64.
[2] R. Wideroe, *Arch. Elecktrot*, 1929, **21**, 387.
[3] Sloan and Lawrence, *Phys. Rev.*, 1931, **38**, 2021.
[4] Lawrence and Livingston, *Ibid.*, 1932, **40**, 19.
[5] ———, *Ibid.*, 1934, **45**, 608.
[6] — and Cooksey, *Ibid.*, 1936, **50**, 1131.
[7] Henderson and White, *Rev. Sci. Inst.*, 1938. **9**, 19.

Sedov Arctic Expedition

THE Second Anniversary of the drift of the Soviet ice breaker "Sedov" fell on the 23rd October. The drift of this breaker which bears the name of the celebrated arctic explorer, Georgi Sedov, began on October 27, 1937, in the Laptev Sea at 75° 19′ N. lat. and 132° 25′ E. long. The bearings on October 20 were 80° 36′ N. lat. and 26° 12′ E. long.

From the astronomical and meteorological data collected, it has now been established that the ice moves along isobars. This conclusion is of much practical significance, for from the data relating to the distribution of atmospheric pressures in the Arctic basin it would be possible to determine the shift of sections of ice in the central Arctic region. The hypothesis that ice moves from East to West under the influence of winds in a circular clockwise direction, with its centre near the "pole of inaccessibility" situated between 83° and 85° N. lat., first enunciated by the Russian Arctic Expedition, headed by Toll in 1900–03, has now been confirmed. The cause for such a remarkable phenomenon is the existence of more or less permanent stretches of open water or fissures in the region north of Greenland and north of the New Siberian Islands and Wrangal Island. The depth soundings taken by the Sedov showed that at 86° 26′ N. lat. and 39° 85′ E. long. the depth was greater than 5,180 meters.

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On Waring's Problem

Let $G(k)$ denote the least integer s such that the Diophantine equation

$$N = x_1^k + \cdots + x_s^k$$

is solvable for all sufficiently large positive integer N, where $n, x_1, \ldots x_s$ denote positive integers.

The upper limits for G(5) have been given by various writers ranging from Hardy and Littlewood to L. K. Hera. The best result known hitherto is $G(5) \leqslant 28$, due to Hera. The author of this note has been able to improve this to

Theorem $G(5) \leqslant 25$.

The author has been able to arrive at this result by improving, among other things, a theorem of Davenport on 'admissible exponents', *viz.*, lemma 1. Suppose that $\lambda_1, \ldots \lambda_s$ are admissible exponents and that $1 - \frac{1}{k} < \lambda, < 1$. Then $1, \lambda_1, \ldots \lambda_s$ are admissible exponents, provided that there exists an integer l satisfying

$$1 \leqslant l \leqslant k_{2-},$$

$$k\lambda_1 - (k-1) \leqslant \frac{1}{2^l}$$

$$(2^l - 1)[k\lambda_1 - (k-1)] + \sigma \leqslant l + 1 \quad (\sigma = \lambda_1 + \cdots + \lambda_s).$$

This theorem is not powerful enough for $k > 3$ since it does not lead to an admissible set $1, x_1, \ldots \lambda_s$ such that $1 + \sigma > k - 1 + \frac{1}{2^{k-2}}$

But this can be improved by the

lemma 2. Suppose that $1, \lambda_1, \ldots \lambda_s$ are admissible exponents.

Then $1, \theta, \lambda_1\theta, \ldots \lambda_s\theta$ are admissible exponents where $\theta = 1 - \frac{1}{k}$.

Other consequences of lemma 2 are

$$G(6) \leqslant 40 \text{ and } G(7) \leqslant 56.$$

These are also improvements on the previous results.

K. Sambasiva Rao.

Department of Mathematics,
Andhra University, Waltair,
October 23, 1939.

Drift of the Hysteresis Loop in Sorption

That "Hysteresis in Sorption" is real[1,2,3,4,8] and is perfectly reproducible [10] a large number of times in some cases and that the concept of cavities[6] having narrow necks, is a general cause[10] of the hysteresis effect, have already been established. For the non-existence or the disappearance of the hysteresis loop, however,

one of the causes has been shown to be the elasticity of the cavity wall.[9] In the present investigation, a series of sorptions and desorptions of water vapour at 30° C. have been conducted on ferric oxide gel[11] activated at 200° C. and degassed in vacuum ($2 \cdot 10^{-4}$ mm.), for five hours, with the aid of a quartz fibre spring balance. Some of the results are shown in Fig. 1. The results indicate a unique behaviour as seen from the following striking

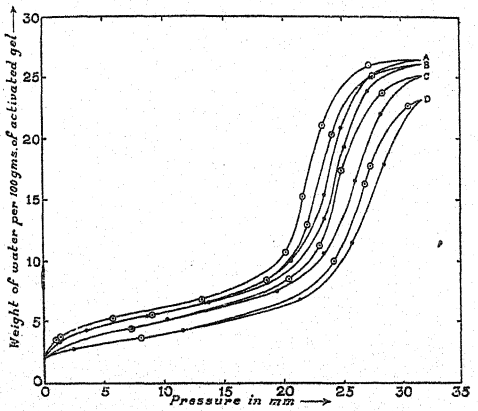


Fig. 1

A. *Second sorption* ←—→ *and desorption* o—o—o
B. *Fourth* " " " "
C. *Seventh* " " " "
D. *Tenth* " " " "

characteristics. With progressive sorptions and desorptions, (*a*) The sorptive capacity of the gel at the saturation pressure diminishes, (*b*) The hysteresis loop becomes smaller, (*c*) The hysteresis loop drifts away from the axis other than that of pressure, (*d*) The tail-end of the hysteresis loop which extends up to zero pressure in the second cycle of sorption and desorption tapers away from zero pressure in the subsequent cycles, (*e*) The gel retains some amount of water irreversibly at the end of first cycle of sorption and desorption which remains practically unaltered in the subsequent cycles.

The sorption isotherm as in the case of titania gel-water system[10] shows an inflection beyond which there is a rapid rise in the sorptive capacity of the gel. Such an inflection clearly indicates, as in copper oxide-water system,[7] a change in the nature of the process, *i.e.*, a change from monomolecular adsorption to capillary condensation. In the porous ferric oxide gel, some of the capillaries are open pores and some are cavities having narrow necks, the latter being responsible for the hysteresis effect. The decrease in the sorptive capacity of the gel at saturation pressure, indicates a decrease in the total capillary volume. If there were no cavities in the gel, there would be no hysteresis loop and the sorption and the desorption curves would be coincident. Assuming that the area of the hysteresis loop is a measure of the total cavity volume, the fact that the hysteresis loop becomes smaller, with progressive sorption and desorption, shows that the total cavity volume decreases. The continuous drift of the hysteresis loop and the tail-end of the hysteresis loop terminating away from zero pressure suggest that the diameters of the cavities and their necks are continuously increasing. The tendency of the sorption and desorption curves to come close to each other indicates a decrease in the disparity between the diameters of the cavities and their necks. So each cycle of sorption and desorption results in the widening of the cavities and their necks and the diminution in the total cavity volume. All these changes indicate that in ferric oxide gel-water system, with progressive sorptions and desorptions, the colloidal particles coalesce with the production of bigger particles. In fact, the above changes simulate those taking place in a definite mass of a system of closely packed spherical particles, as progressive increase in the size of the particles proceeds.

This is a unique case of a continuous drift with other changes of the hysteresis loop, resulting from progressive sorption and desorption of water vapour and is different from the one predicted by Leonard H. Cohan.[5] No such drift is noticeable in the sorption of water vapour on gels of titania and silica.[10] Sorption and desorption of carbon tetrachloride at 30° C. on another sample of the same ferric oxide gel have been conducted. There is a hysteresis loop which suffers no such drift. The second and the third hysteresis loops are identical with the first and the sorptive capacity at saturation

pressure remains the same. The permanent and reproducible hysteresis loop has also been scanned as in the case of titania gel-water.[10]

It is probable that this interesting colloidal behaviour of ferric oxide gel is connected with its thixotropic property. By virtue of thixotropy, the particles have the facility[12] to coalesce. Whether other thixotropic systems behave in a similar way, is a question to be decided by further investigations which are in progress.

A study of the interesting phenomena *vide infra* accompanying successive sorptions and desorptions of water vapour has thrown much light on the changes in the fine structure of ferric oxide gel. Such a study necessitating the operation of a series of sorptions and desorptions of the vapour on the same sample of the adsorbent in vacuum, has been possible by the excellent advantages of the quartz fibre spring technique.

KITTUR SUBBA RAO.

Department of Chemistry,
Central College,
Bangalore,
November 30, 1939.

[1] Allmand, Hand and Manning, *J. Phys. Chem.*, 1929, **33**, 1694.

[2] Burrage, *Trans. Faraday Soc.*, 1934, **30**, 317.

[3] Foster, *Proc. Roy. Soc. Lond.*, 1934, **146A**, 129.

[4] Lambert and Foster, *Ibid.*, 1932, **136A**, 363.

[5] Leonard H. Cohan, *J. Amer. Chem. Soc.*, 1938, **60**, 433.

[6] McBain, *Ibid.*, 1935, **57**, 699.

[7] —— *Sorption of Gases by Solids*, George Routledge and Sons, Ltd., London, 1932, 443.

[8] Pidgeon, *Canad. J. Res.*, 1935, **12**, 41; 1934, **10**, 713.

[9] Rao, K. S., *Curr. Sci.*, 1939, **8**, 256.

[10] ——, *Ibid.*, 1939, **8**, 468.

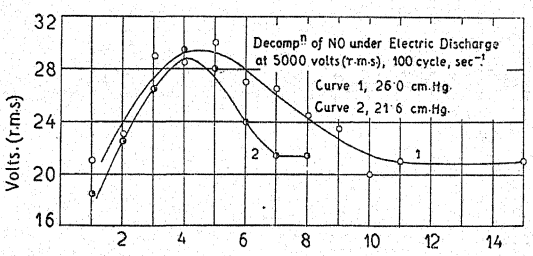
[11] —, and Rao, B.S., *Proc. Ind. Acad. Sci.*, 1936, **4**, 562.

[12] Weiser, *The Colloidal Salts*, John Wiley & Sons, Inc., New York, 1933, **3**, 374.

Threshold Potentials and Reactivity under Electrical Discharge

IT was observed earlier[1] that time-variations in the electrical quantities such as the magnitude of the ionisation current flowing through, and the energy consumed in the reaction space were of significance in an analysis of the corresponding reaction-time curves. These studies were carried out in Geissler-, triode-type vessels and in the annular space of the Siemens' ozoniser. For a variety of reasons, especially the possibility of enabling an exposure of a predetermined mass of a gas to a field which can be calculated with a fair precision on a comparatively simple theory,[3] the last type of the vessel is well adapted. A factor which has hitherto been practically entirely ignored by workers in the field of reaction kinetics under electric discharge, has now been observed in the existence of a threshold potential, V_m; this minimum of potential has to be exceeded in order to initiate the change in a given reactant material, which may be (*a*) pure or (*b*) a mixture. Almost in every case (the possibility of the explosive reactions constituting a general exception is being investigated) there is a sudden change, usually an increase, in the current through, and the wattage dissipated, in the system, besides the familiar manometric or chemical indication of an insipient reaction, at V_m. It is characteristic both of the reaction and nature of the material. The V_m values for (*a*) are identifiable with, or simply related to the corresponding Paschen potentials; work is now in progress on the position in respect of (*b*).

It has been found that a determination of V_m, the threshold potential, serves markedly to throw light on the mechanism of a complex, especially a consecutive chemical reaction. Curves in Fig. 1 illustrate the variation of V_m for the reactant material determined at different times during the decomposition of nitric oxide



TIME IN MINUTES OF EXPOSURE TO DISCHARGE

FIG. 1

due to 5000 volts (r.m.s.) at two initial pressures. They are remarkably similar to the familiar concentration-time curves characteristic of the intermediate compounds in consecutive reactions. This, together with a general finding in these Laboratories that admixture even in traces of a component with a large 'electron affinity' increases V_m, suggested the intermediate occurrence of nitrogen peroxide in the decomposition of nitric oxide under the discharge. Later, this deduction was fully confirmed by direct optical and analytical examination of the decomposition mixture at the intermediate stages of the reaction. This examination entails on the one hand, an accessory and by no means simple manipulation, and is liable on the other, to disturb the chemical state of the mixture. Such limitations are, however, absent in the threshold potential determinations, which can be carried out with the reaction mixture *in situ*, whilst giving an adequate indication of the occurrence of any intermediate reaction, and are of general applicability.[2]

Further work has shown that the threshold potential measurements are markedly sensitive to change, when a discharge reaction is produced under an *additional* constraint, such as irradiation, a magnetic field, an altered temperature or frequency of the A.C. supply. Moreover, even in such quasi-chemical changes, as the induction of the 'latent image' on a photographic plate, activation of nitrogen, its deactivation, or spectral shift in the 'after glow', V_m has been found to be the chief determinant of both their inception and time rate.

S. S. Joshi.

Department of Chemistry,
Benares Hindu University,
Benares,
November 8, 1939.

1 Joshi, *Trans. Farad. Soc.*, 1927, **23**, 227; 1929, **25**, 108, 138, 143.

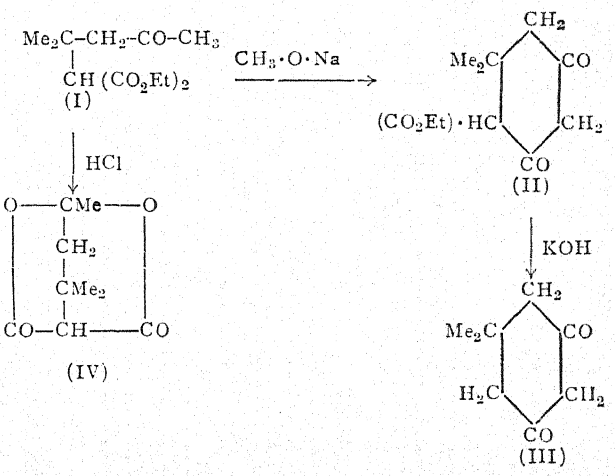
2 ———, *loc. cit.*, 1929, **25**, 120.

3 Warburg, *Ann. Physik*, 1909, **28**, 1-17; Lunt, *Phil. Mag.*, 1925, **49**, 1238.

Reformatsky Reaction with Ethyl Bromomalonate and Acetone

The classical Reformatsky Reaction,[1,2] for the synthesis of β-hydroxy esters has been studied by several workers with α-halogen esters of various monocarboxylic acids on ketones or oxides. The study of this reaction is now being pursued with α-halogen esters of dicarboxylic acids.

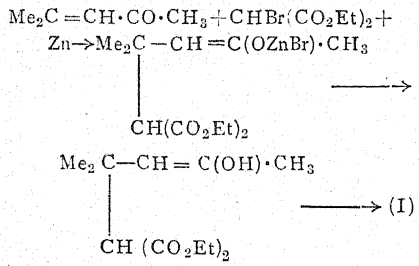
Instead of giving the expected β-hydroxy ester, the condensation of ethyl bromomalonate with acetone in presence of zinc, follows an unexpected course where one molecule of the ester reacts with two molecules of the ketone leading to the formation of ethyl acetonyl-*iso*-propyl-malonate (I), b.p. 125–137°/4 mm. (semicarbazone m.p. 74–75°). The results of analysis, the molecular weight determination and its cyclisation with sodium methylate to Vorländer's ester[3] (II)—not isolated—with subsequent hydrolysis to 5 :5-dimethyldihydroresorcin[4] (III) definitely establishes the identity of (I). On hydrolysis with hydrochloric acid, ester (I) gives the dilactone (IV) m.p. 135–136°.



Qudrat-i-khuda[5] has prepared (II) and (IV) from 6-hydroxy-2-keto-3-cyano-4 :4 :6-trimethylpiperidine obtained by the condensation of mesityl oxide with cyanacetamide. A comparison of the present products with those of Qudrat-i-khuda also confirmed their identity.

The mechanism of the reaction is explained

as follows. First of all two molecules of acetone condense to form mesityl oxide. Afterwards, in analogy with the observations of Kohler *et al*,[6] the zinc compound of ethyl bromomalonate adds on to it in 1 : 4-positions leading to the formation of (I) as under.



The full paper will be published elsewhere.

BALKRISHNA H. IYER.

Department of Pure and Applied Chemistry,
Indian Institute of Science,
Bangalore,
December 10, 1939.

[1] Reformatsky, *J.R.C.S.*, 1890, **22**, 49; *British Chemical Abstracts*, 1891, **60**, 169.
[2] W. H. Perkin, *J.C.S.*, 1896, **69**, 1482.
[3] Vorländer, *Annalen*, 1897, **294**, 300.
[4] —, and Erig, *Ibid.*, 1897, **294**, 314.
[5] Qudrat-i-khuda, *J.C.S.*, 1929, 201.
[6] Kohler, Heritage and Macleod, *Amer. Chem. J.*, 1911, **46**, 217.

Magnetic Susceptibilities of Some Fluorides

THE susceptibilities of fluorides of Li, Na, S, K, Ca, Mn, Co, Ni, Ge, Se, Rb, Sr, Mo, Te, Cs, Ba, W, Tl, Pb, U, Ce and Nd have been already studied by various investigators.[1,2]

Susceptibilities of fluorides of Mg, Al, Cd, Cr, Fe, Cu, Zn, Ce, Hg, Bi and fluoride of KBe have now been determined by me using the usual Gouy method.

The electromagnet was constructed in our laboratory. It gives a maximum field of 13,000 Gauss at 22 Amp. and 110 volts with an air gap of 1·0 cm. All the salts except MgF_2 (Kahlbaum, Berlin), $KBeF_2$ and FeF_3 (Chemiche Fabric, Gorlitz), were prepared by British Drug House, London. They were packed in thin glass tubes and the mass susceptibilities were calculated by the usual formula,

$$F_x = \tfrac{1}{2}A(K_1 - K_2)(H_1^2 - H_2^2)$$

where A is the area of cross-section of the specimen, F_x is the magnitude of the force on the specimen, K_1 and K_2 the volume susceptibilities of the specimen and the medium respectively, and H_1 and H_2 the fields at the lower and upper ends of the specimen. (Volume Susceptibility = Density × Mass Susceptibility.)

The results after applying various corrections are as follows:—

Salt	Temperature	Mass Susceptibility × 10^6
	°C.	
MgF_2 ..	28·0	+ 0·40
AlF_3 ..	29·2	− 0·16
CdF_2 ..	29·0	− 0·25
CrF_3 ..	32·0	+ 91·20
FeF_3 ..	32·0	+122·00
CuF_2 ..	32·2	+ 23·00
ZnF_2 ..	26·6	− 0·37
CeF_3 ..	29·0	+ 10·90 (standard value[3] = 11·10 at 20° C.)
BiF_3 ..	29·8	− 0·23
HgF_2 (oxy) ..	29·0	− 0·26
HgF_2 (ous) ..	29·0	− 0·24
$KBeF_2$ ..	28·6	− 0·60

Detailed account will be published elsewhere.

I am grateful to Mr. U. Durrani, Superintendent, Technical Institute, Muslim University, Aligarh, for his kind help in constructing the electromagnet and helpful discussions.

ABDUL AWWAL CHOWDHURY.

Physical Laboratories,
Muslim University,
Aligarh,
November 30, 1939.

[1] *A.T.C.*, Paris, 1937, **8**, 23—2.
Ibid., 1937, **17**, 23—6.
[2] Landolt's Bornstein, *Tables of Constants*, Springer, Berlin, 1923, **2**, 1198; 1936, **3**, 2180.
[3] —, *Ibid.*, 1936, **3**, 2181.

Growth Promoting Factors in Jowar (*Andropogan Sorghum* Linn.)

IN the course of our feeding experiments with the rice moth, *Carcyra ciphalonica*, it was found that the insect needs a water-soluble factor and also one which is fat-soluble. Whole jowar, dried and powdered to pass through a 30-mesh sieve, when fed to these insects, has been found to constitute an adequate diet, but the material subjected to an extraction with ether, does not support the growth of the insect, although the diet is supplemented with an equivalent quantity of fat in the form of groundnut oil. The addition of the ether extract to the extracted meal, however, restores the adequacy of the diet, although the diet suffers in quality to a certain extent. This deterioration in quality is attributed to a partial destruction of the fat-soluble factor in the course of the preparation of this diet.

Batches of ten larvæ were fed on three different diets (1) whole jowar, (2) jowar extracted with ether but the fat deficiency made up by groundnut oil and (3) ether extracted jowar to which an equivalent quantity of the extract has been added. Results of these experiments have been graphically represented in Fig. 1, which

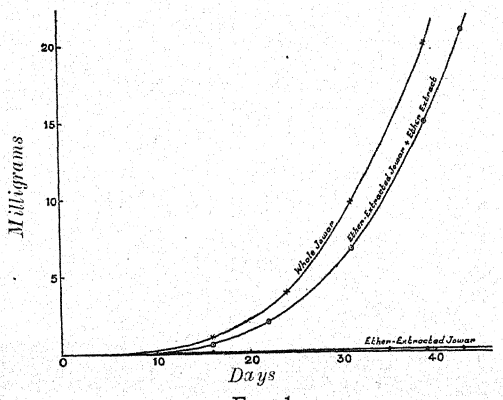


FIG. 1.
Growth curves of the rice moth (*Carcyra ciphalonica* fed on different diets
Scale—x axis 1 cm. = 2 days
y axis 2 cm. = 2·5 mgms.

demonstrates in a convincing manner, the presence of a potent fat-soluble, growth-promoting factor in the ether extract. Experiments with a view to isolate this factor in a concentrated if not a pure form, are now in progress.

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Indian Institute of Science,
Bangalore,
December 5, 1939.

Nitric Nitrogen in Soils under Cotton

A GENERAL complaint in the cotton growing districts of the Punjab is that American varieties of cotton do not often give successful crops. At the flowering stage the plants usually become yellowish green in colour, and at times there is a considerable shedding of leaves and flowers and bad opening of bolls. This trouble has also been encountered in Sind.

Since soils in tropical countries are generally deficient in nitrogen, the yellowish green appearance of plants led us to suspect nitrogen starvation at the time of seed formation when it is most required. Preliminary observations on the amount and type of nitrogen in soils under cotton were taken in 1928. These showed a deficiency of available nitrogen in such soils.

In 1929 and again in 1933, with the assistance of the Cotton Research Botanist weekly determinations of different forms of nitrogen were made during the entire cotton season. These were correlated in 1929 with the types of micro-organisms present in fallow and the cropped soils.

The results of such observations (Table I) showed that the amount of nitric nitrogen in soils under cotton was practically nil from about the end of July onwards.

Another set of observations was taken in September this year (1939). Determinations for available nitrogen were made in samples of soil removed from 16 different fields under American cottons at Risalewala and Lyallpur Agricultural Farms. The amount of available nitrogen was found to be practically nil in all these (Table II).

TABLE I

Mgm. Nitric Nitrogen per 100 gms. of Soil

Year 1929	Fallow	Under Cotton	Year 1933	Fallow	Under Cotton
29th July	1·43	Nil	31st July ..	1·2	0·56
5th Aug.	1·80	Nil	7th Aug. ..	1·2	0·33
10th ,, ...	2·14	Nil	14th ,, ..	1·27	0·71
19th ,, ...	1·31	Nil	21st ,, ..	1·50	0·90
26th ,, ...	1·65	Nil	27th ,, ..	0·70	Trace
2nd Sept.	2·00	Nil	11th Sept. ..	0·33	0·18
10th ,, ...	1·90	Nil	18th ,, ..	1·01	0·52
17th ,, ...	1·62	Nil	25th ,, ..	0·63	0·30
23rd ,, ...	1·50	Nil	2nd Oct.	0·60	0·22
2nd Oct.	2·90	Nil	9th ,, ...	0·35	0·09
7th ,, ...	1·50	Trace	15th ,, ...	0·52	0·11
21st ,, ...	2·85	,,	23rd ,, ...	0·52	0·22
30th ,, ...	2·92	,,	30th ,, ...	0·52	0·26
5th Nov.	2·85	,,	6th Nov. ..	0·90	0·27
12th ,, ...	2·30	0·62	12th ,, ..	0·60	(0·15)
20th ,, ...	2·80	0·58	20th ,, ..	0·9	0·11

TABLE II

Mgm. Nitric Nitrogen per 100 gms. of Soil

S.No.	Field No.	Variety of cotton	Nitric N. Mgm.	S. No.	Field No.	Variety of cotton	Nitric N. Mgm.
1	Risalewala Farm B/8	43F	Trace		Lyallpur Agricultural Station		
2	,, ,, B/10	43F	,,	9	,, ,, 3/23	L.S.S.	Nil
3	,, ,, B/12	43F	Nil	10	,, ,, 3/24	K.T.25	,,
4	,, ,, E/4	L.S.S.	,,	11	,, ,, 3/25	L.S.S.	,,
5	,, ,, E/8	L.S.S.	,,	12	,, ,, 4/21	L.S.S.	,,
6	,, ,, E/12	L.S.S.	0·02	13	,, ,, 5/10	L.S.S.	,,
7	,, ,, H/1	L.S.S.	Nil	14	,, ,, 5/11	L.S.S.	,,
8	,, ,, H/2	L.S.S.	,,	15	,, ,, 5/20	L.S.S.	,,
				16	,, ,, 5/21	L.S.S.	,,

Besides nitric nitrogen, estimations of nitrous and ammoniacal nitrogen were also made. Nitrous nitrogen was found to vary from 1/100th to 1/20th of a mg. per 100 gms. soil while ammoniacal nitrogen was generally present in traces only.

It appears, therefore, that deficiency of available nitrogen in soils under cotton at the fruiting stage of the crop may have something to do with its partial failure.

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Agricultural Research Institute,
Lyallpur,
October 6, 1939.

Occurrence of Celestite in the Phosphatic Nodules of Utatur

SEVERAL investigators[1,2,3] have reported on the extensive deposits of phosphatic nodules in the Utatur area. Crushed specimens of phosphatic nodules revealed the presence of a white platy mineral which filled the cracks in the nodule and appeared to have concentrated near the core. Since it could be easily loosened and isolated and also since it comprised more than 3 per cent. (even 10 per cent. in exceptional cases) of the entire nodule, it was obtainable in sufficient quantity for study.

A careful chemical examination which involved the separation of calcium, strontium and barium by reliable methods showed that the mineral consisted approximately of 93 per cent. of strontium sulphate, 4 per cent. of the sulphates of calcium and barium and 3 per cent. of quartz.

We have also examined a lump of celestite occurring in the gypsum beds in the same area. This specimen was a massive aggregate of columnar crystals each of which was 10–12 mm. long.

In view of the fact that no significant deposits[4,5,6,7] of strontium minerals in India have so far been known to exist, this finding of a large source of strontium compounds in the Utatur area appears to be of some importance to this country.

A detailed study of the occurrence of celestite and of other minerals occurring in the Utatur area is now in progress.

N. JAYARAMAN.
K. R. KRISHNASWAMI.

Dept. of General Chemistry,
Indian Institute of Science,
Bangalore,
December 12, 1939.

[1] Blanford *Mem. Geol. Surv. Ind.*, 1862, **4**, 83.
[2] Sivan, *Year Book of the Mad. Agric. Dept.*, 1918.
—, *Proc. Ind. Sci. Cong.*, 1922, 29.
—, *Ibid*, 1924, 44.
[3] Rama Rao, *Quart. Jour. Gwol. Min. Met. Soc. Ind.*, 1931, **4**, 49.
[4] Blanford, *Mem. Geol. Surv. Ind.*, 1880, **17**, 196.
[5] Coggin Brown, *India's Mineral Wealth*, 1936, 277.
[6] Jones, *Rec. Geol. Surv. Ind.*, 1888, **21**, 36.
[7] Hughes-Buller, *Ibid.*, 1904, **31**, 45.

A Note on the Effect of Indole-butyric and Indole-acetic Acids on Rooting of Green Wood Cuttings with Special Reference to Litchi and Mango

PRELIMINARY results obtained during the summer of 1939 definitely indicate the effectiveness of indole-butyric acid in stimulating root growth in cuttings of litchi and a hedge plant, namely, *Justicia gendarusa* Linn. The time allowed (60 days) was found too short for rooting in mango but the effect of the chemicals was evident in callus growth. The importance[1] of propagation by cutting, if really practicable, would be very great in litchi and mango. The present methods of marcotting of litchi, and inarching of mango using seedling stocks are not only tedious but also do not give satisfactory results.

In the present experiments, cuttings about 6 inches in length were taken from one- and two-year old shoots, during the last week in March 1939. All leaves were removed and the cuttings immersed to a depth of about 1 inch in various concentrations of a water solution (tap water) of indole-butyric and indole-acetic acids for 6, 12, 24 and 48-hour periods. After treatment the cuttings were planted to about two-third of their length in a sand bed. These were excavated after 60 days. The *justicia* sp.

is not difficult to root. Ordinarily it is propagated by cuttings and, therefore, it was used in these experiments with a view to provide a check on the methods employed.

Between the two acids, indole-butyric was found more effective and in all cases maximum effect was obtained where the highest concentration was applied for the longest period. Fig. 1 is a photograph showing the effect

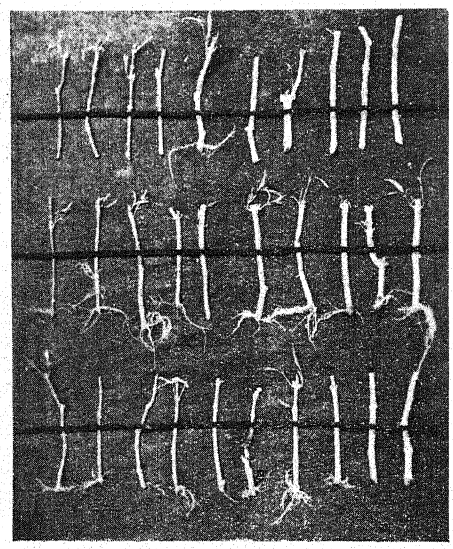

FIG. 1

Showing rooting in *Justicia gondarusa* cuttings, the top line shows the controls, the middle line the ones treated with indole-butyric acid and the bottom line treated with indole-acetic acid.

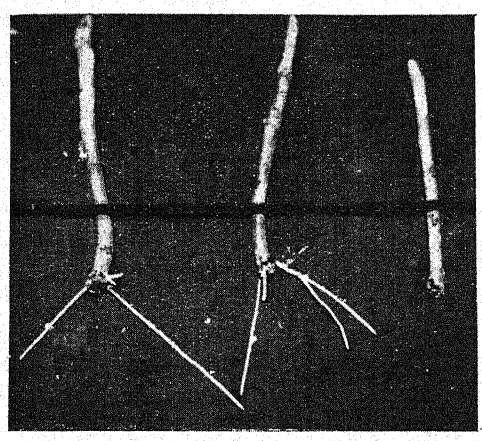

FIG. 2

Showing rooting on *Litchi* cuttings treated with indole-butyric acid.

on *justicia* cuttings of the three treatments, namely, control, 60 mgr. indole-butyric acid per litre and 48-hour period, and 60 mgr. indole-acetic acid per litre and 48-hour period on the top, middle and bottom rows respectively. Fig. 2 shows rooting in litchi cuttings. In this case actual rooting was obtained only under the treatment of 60 mgr. indole-butyric acid per litre and 48-hour period. The detailed data of these experiments have been presented in the *Annual Report* of the Fruit Research Station, Sabour, for 1938–39.

Thanks are due to the Imperial Council of Agricultural Research as this work has been taken up at their instance under a Scheme financed by them.

P. K. SEN.

Fruit Research Station,
Sabour, Bihar,
August 18, 1939.

[1] Sen, P. K., *Hort. Res. Sta. of U.P. and Bihar*, Sabour, 1937–38, Pt. II, pp. 54–60.

Tanaka Tyozburo, *Phil. J. Agri.*, 1939, **10**, No. 1.

'Thermo' or 'Vacuum' Flasks for Preserving Sugarcane Pollen

SUGARCANE pollen loses viability fairly quickly —sometimes in less than four hours—under the ordinary field or laboratory conditions. Experiments in the past had, however, shown that under conditions controlled for temperature and humidity certain sugarcane pollens can be preserved for as many as nearly thirteen days.[1, 2] A simple, cheap and portable arrangement for thus preserving the pollen had, however, been a desideratum.

The device illustrated herein (Fig. 1) utilising the easily available thermo or vacuum flask has shown usefulness in preserving cane pollen already for the period above mentioned and the periodical testing for viability is still in progress.

A is a test tube, rubber stoppered at the top, carrying a specially designed staging M in which cane pollen of four different kinds could be stored in small watch glasses. This tube A is the store chamber for the pollen desired to be preserved. H is a mixture of sulphuric acid and water in suitable proportions for securing

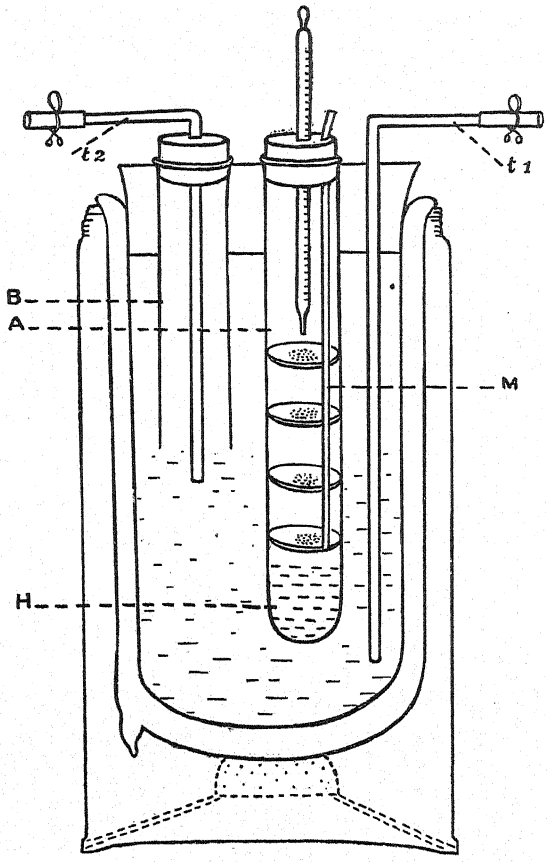

FIG. 1

the humidity desired. The tubulatures t_1 and t_2 are for maintaining the water inside the flask and hence the atmosphere inside the pollen store chamber at the desired temperature. This is secured by introducing through the tube B calculated quantities of ice based on the general formula for the measurement of heat of fusion of ice by its mixture with water. Either of the tubulatures may be utilized for letting out the water from the flask as needed by the well-known syphon principle.

The apparatus illustrated is simple, made from easily available material like the thermo food jar and has the great advantage of portability. It should, therefore, be of particular use when pollen has to be transferred over distances. It has been possible with this device to maintain the temperature in the test tube in which pollen is kept for storage at fairly constant temperatures ranging from 5° C. to 16° C. with a variation of 1·8° C. during a period of two days after which a suitable recharging is needed.

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Imperial Sugarcane Station,
Lawley Road, Coimbatore,
November 24, 1939.

[1] Vekataraman, *Agri. Jour. Ind.*, 1922, **17**, 127.
[2] Dutt, *Ibid.*, 1929, **24**, Pt. IV, 255.

On Resistance of Vernalised Plants of Linseed to attack by *Melampsora Lini*

DURING the course of investigation by Mr. Gurbachan Singh (1938–39 session) on the effect of different periods of pre-sowing cold treatment of certain plants, an important observation was made, *viz.*, treated linseeds were found to be less liable to the attack of the rust, *Melampsora Lini* than the untreated ones. Linseed seeds T_5 and T_{10} from Lyallpur were given pre-sowing cold treatment. These along with the control plants were grown in small plots in the Botanical Garden, where Linseed varieties E.B.Z. and O.S.X. from Nagpur were also growing in contiguous plots. The latter two are susceptible varieties and were attacked by the rust early in March. From these, first the control plants of T_{10} and a few days later the control plants of T_5 were infected. The treated plants were the last to be infected and those treated for the longest period, *viz.*, two weeks (other sets were exposed to cold for 1½ and 1 week) had very little rust infection and many of the plants escaped infection altogether and those that were infected, showed very little actual damage. The experiments are being repeated this session and the details of these experiments will be published by Mr. Gurbachan Singh as soon as completed.

So far very little evidence of resistance to disease due to vernalisation in plants is available. Only positive evidence is that of Nemlienko on resistance of vernalised plants to bunt disease. The present evidence of resistance to

rust seems to have great potentiality. It is being tried on wheat plants for resistance to different wheat rust and the result will be published in due course.

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November 25, 1939.

A Note on the Structure and Development of the Ovule and Embryo-sac in Two Species of *Launea*

THE literature on the embryology of the Indian members of the family compositæ is limited to the works of Bhargava[1] on *Eclipta erecta* and Banerji[2] on *Carthamus tinctorius*.

The writer has for some time been studying the embryology of some Indian members of the above family and the present note deals with the structure and development of the ovule and embryo-sac in *Launea nudicaulis* and *Launea pinnatifida*. When my observations were almost ready for being sent to the press, Sunil Datta[3] published a note on the development of the female gametophyte in *Mikania cordifolia*, *Blumea laciniata* and *Launea asplenifolia*. My observations on the two species of *Launea* agree in all respects with his except in the development of the 'cover cells'.

In the two species forming the subject of this note the single basal ovule is anatropous and one-integumented. It has a very scanty nucellus. The single archesporial cell is hypodermal. It directly becomes the megaspore mother-cell without cutting off a cover cell. On completion of the first and second meiotic divisions the megaspore mother-cell forms a linear tetrad (Fig. 1). The chalazal megaspore is the functional one and forms the uni-nucleate embryo-sac. The three micropylar megaspores degenerate. A normal 8-nucleate embryo-sac is formed from the uni-nucleate embryo-sac after three successive free nuclear divisions in it. The embryo-sac shows the normal structure. The egg has the usual form, with a prominent micropylar vacuole and the nucleus in the dense cytoplasm at the chalazal end. The two synergids lying on either side

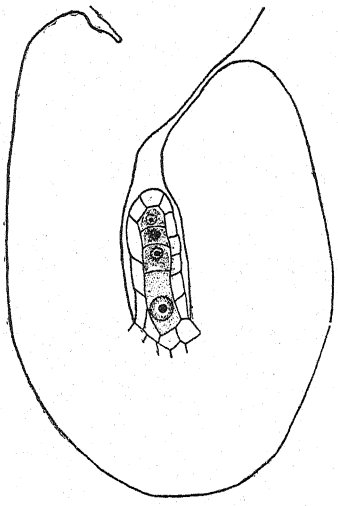

FIG. 1

of the egg are pear-shaped with pointed micropylar ends which are filled with dense cytoplasm. They have a nucleus each in the micropylar part and bear the usual chalazal vacuoles. The antipodals are uni-nucleate and are formed either in a row or arranged in a triangular form in the chalazal end of the embryo-sac. The polar nuclei meet at about the middle of the embryo-sac and move upwards. They fuse with each other and form the secondary nucleus which finally takes its position near the egg. The fertilization is porogamous.

The single layer of nucellus begins to degenerate at about the time when the embryo-sac becomes two-nucleate (Fig. 2). By the time the embryo-sac attains the mature form the whole nucellus disappears and the embryo-sac lies within the jacket of cells formed by the innermost layer of cells of the single massive integument (Fig. 3). The cells of this layer get a little elongated, become rich with protoplasmic contents and serve as the tapetum. This is found in many compositæ. According to my observations in the two species of *Launea*, neither the megaspore nor the embryo-sac becomes deep-seated due to the development of cover cells. Sunil Datta in his note states that in the species he studied, the megaspores become deep-seated due to the development of

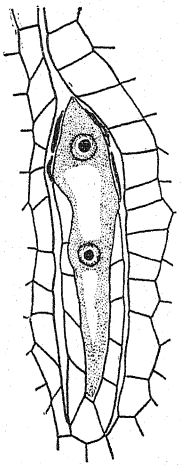

FIG. 2

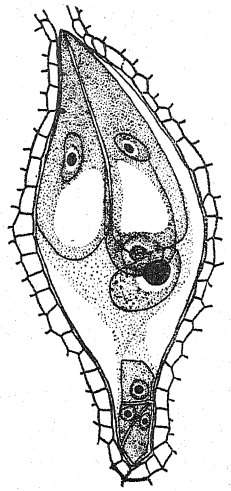

FIG. 3

cover cells, although he himself states in an earlier part of his note that the single hypodermal archesporial cell functions directly as the megaspore mother-cell. When a cover cell is not cut off primarily there could be no further development of cover cells to make either the megaspore or any structure resulting from it deep-seated. The extensive literature cited by Schnarf[4] in his book in connection with the embryology of compositæ and the observations made more recently by Bhargava on *Eclipta erecta* and Banerji on *Carthamus tinctorius* are in complete accord with my observations.

A detailed account of the development of flower, pollen, ovule, embryo-sac and embryo will be published elsewhere in due course.

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Andhra University,
Waltair,
November 1, 1939.

[1] Bhargava, H. R., *Proc. Ind. Acad. Sci.*, Series B, 1935, **1**, No. 7.

[2] Banerji, I., *Proc. Ind. Sci. Cong.*, Part III, 1938.

[3] Sunil Datta, *Curr. Sci.*, 1939, **8**, 472.

[4] Schnarf, K., *Vergleichende Embryologie Der Angiospermen*, 1931.

The Age of the Earth

(According to the Hindu 'Shastras')

VERY little reference has been made to the views expressed in the religious books ('Shastras') of the Hindus when tracing the evolution of ideas about the age of the earth. Shand[1] does not refer to them at all; whereas Holmes only says, "Opposed to these limited ideas of a definite beginning, the old Brahmins of India regarded time and the earth as eternal".[2]

Both in the *Sankhya* and in the *Vedanta* philosophy of the Hindus, the Creation and Destruction of the World have been regarded as Cyclic in nature, like day and night. The total time of the Creation has been termed a "Kalpa" or a day of 'Brahma', the Creator. According to the ancient books of the Hindus—both socio-religious and astronomical, like the *Manu Smriti* (Chap. 1, stanzas 63–73) and the *Surya Siddhanta* (Chap. 1, stanzas 15–20)—a "Kalpa" is composed of 14 'Manvantaras' together with 13 time-intervals between them, each interval being of 1,728,000 years. Each 'Manvantara' itself is composed of 71 cycles of 'Chaturyugas'. A 'Chaturyuga' is the sum of four 'yugas' or eras, including the time-intervals between each of them. The four eras are 'Satya-yuga', 'Treta-yuga', 'Dwapur-yuga' and 'Kali-yuga'. Kali-yuga is of 432,000 years' duration, and Dwapur, Treta and Satya yugas are respectively double, treble and four-times the Kali-yuga. The figures for the various eras include also the time-interval which precedes and follows each era. From these figures, the duration for which this World is supposed to last is estimated to be 4,320 million years.

The age of the Earth from its beginning to the present time is termed in Hindu astronomical Calendars as 'Shrishti-Samvat' (year of Creation), and is often recited by the Hindus in the 'Sankalpa Mantra' during their religious rites. In this recitation of a few lines, the Hindu is reminded that since the beginning of the Creation of this world, six 'Manvantaras' and 27 'Chaturyugas' have already passed away, and we are at this time in the 5040th year (in

A.D. 1939) of the 'Kali-yuga', the last era of the 28th 'Chaturyuga'.[3] The total time through which the earth has already endured thus works out to be 1,972,949,040 years in the Hindu Calendar. It is wonderful how this "Srishti-Samvat" of the Hindus agrees so well with the recent geo-physical estimates of the age of the earth (about 2,000 million years).

N. L. SHARMA.

Indian School of Mines,
Dhanbad,
November 21, 1939.

[1] Shand, S. J., *Earth lore*, 1927, 42.

[2] Holmes, A., *The Age of the Earth* (Benn's Library Series), 1928, 5.

[3] Tilak, B. G., *Shrimad Bhagwat Gita Rahasya*, Hindi Edition, 1919, 193.

The Constitution of Rottlerin

McGOOKIN, Robertson and Tittensor[1] have advanced a new structure for rottlerin still retaining the CH_3CO group. We shall publish our detailed criticism of this formula as soon as our experiments in progress are completed. In the meanwhile we wish to point out that a solution of 0·5 gr. of rottlerin methyl ether[2] described by us, dissolved in 25 c.c. of chloroform when taken in a 2 dcm. tube showed a rotation of + 0·23 whence the specific rotation is + 5·75. Therefore, rottlerin has an asymmetric carbon atom which we do not find in Robertson's latest formula.

With regard to Robertson's criticism[3] that 'Ray and co-workers maintain that this compound contains a lactone group and also state that in the conversion of tetrahydrorottlerin into octahydrorottlerone by hot alcoholic hydrochloric acid, an acidic substance is formed which apparently is an intermediate product in the rottlerone change. We have repeated the experiments described by the Indian workers and ..... it may be stated that if the experiment is stopped after 8 hours, as these authors describe, the insoluble product appears to consist only of octahydrorottlerone along with unchanged tetrahydrorottlerin, which in a finely divided state we have observed to be soluble in aqueous sodium bicarbonate.' They draw the conclusion that no acidic products are formed and sodium bicarbonate only dissolves the precipitate to a colloidal solution. We wish to state that we have definitely stated that the product is a mixture and did not claim it to be a pure product. We know there is some unchanged tetrahydrorottlerin and a little tetrahydrorottlerone in it but when the mixture is treated with bicarbonate, a good portion remains insoluble. The portion soluble in the bicarbonate solution has now been repeatedly extracted with ether and then on acidification with hydrochloric acid has deposited this acidic substance. The acidic substance so precipitated is freely soluble in ether. The ethereal extract has now been washed nine times with water and tested for the absence of chlorine ion. A few drops of this ethereal solution readily liberates iodine from an aqueous solution of potassium iodide and iodate thus establishing the presence of an acidic substance in the ethereal solution. We are also determining the pH of this ethereal solution. From the above it will be evident that the solution of a portion of the mixture in bicarbonate solution is due to salt formation and not to colloidalisation as Robertson supposes.

We thank Professor Mahan Singh of the Government College, Lahore, for taking the optical rotation for us.

J. N. RAY.
K. S NARANG.
B. S. ROY.

University Chemical Laboratories,
University of the Panjab,
Lahore,
December 16, 1939.

[1] *J.C.S.*, 1939, 1582.
[2] *Ibid.*, 1937, 1864.
[3] *Ibid.*, 1939, 1583.

The Use of Kamala as an Antioxidant of Ghee

By S. V. Govindarajan and B. N. Banerjee
(*Department of Biochemistry, Indian Institute of Science, Bangalore*)

THE problem of prevention of rancidity in natural fats and food preparations containing fats is one which has received considerable attention. The conditions responsible for or favourable to fat deterioration have been well studied. The remarkable variations in the resistance of butterfat to rancidity, and of the vitamin A in the fat to destruction by heat and oxygen, have been attributed to the presence in different amounts of protective substances (Banerjee[1]). Antioxidants and pro-oxidants (promoters) for the control of autoxidation are being increasingly applied in industries. Investigations in the oil and rubber industries in particular have discovered a large range of substances which may be employed to modify the reaction velocity or totally to prevent the deterioration of a product by oxidation or polymerisation.

The work of Olcott and Mattil[2] has shown that three types of substances have a protective action on the oxidation of animal fats (lard): (i) the acid type inhibitors, (ii) the unsaponifiable matter obtained from various vegetables and vegetable oils, and (iii) the phenolic type, *e.g.*, hydroquinone, α-naphthol, pyrogallol, catechol and others. Substances of type (i) can scarcely be added to sensitive foodstuffs like butterfat to help preservation, whilst the use of substances in concentrations exceeding 0·01 or 0·02% of the other types is likely to interfere with taste, flavour, etc.

A search for a substance of such nature that little objection could be taken from these points, has revealed that Kamala dye is satisfactory. It is of vegetable origin, is harmless, odourless and very stable. When dissolved in fats in small amounts it gives a light yellow colour, which is natural to butterfat of good quality. The dye is not soluble in water, but an alcoholic solution dissolves easily in fat.

The effect of the addition of this substance in small concentrations on the oxidation of fat as measured by oxygen absorption at 95° C. is summarised in Table I.

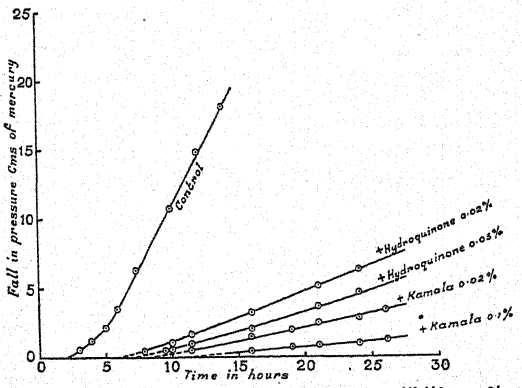
It is seen that the induction period is considerably increased by the addition of even 0·02% of Kamala dye. The rate of oxygen absorption is also reduced by the addition of this inhibitor (Fig. 1).

TABLE I

Substrate Kathiawar Agmark Ghee

Inhibitor added %		Induction period* with inhibitor hours	Anti-oxidative index
0·02	Hydroquinone	6·0	3·0
0·05	,, ...	7·0	3·5
0·02	α-naphthol	5·0	2·5
0·02	Kamala dye	8·5	4·25
0·05	,, ...	9·5	4·75
0·10	,, ...	11·0	5·5
0·02	Citric acid	2·0	1·0
0·20	,, ...	4·5	2·25
0·02	Tartaric	2·0	1·0
0·20	,, ...	3·5	1·75
0·20	Lactic acid	2·5	1·25
0·50	,, ...	1·5	0·75
0·20	Oleic acid	1·5	0·75
0·50	,, ...	1·0	0·5

* Induction period for control 2 hours.



OXYGEN ABSORPTION OF A GHEE SAMPLE (Kathiawar Ghee.
Graph 1

Several substances such as oxalic acid,[3] maleic acid,[4] sulphuric acid and phosphoric acid and their salts[5] and lecithin[6] have been suggested as antioxidants for vegetable fats. Addition of organic acids like citric, tartaric and lactic acids does not increase the period of induction in butterfat, while oleic acid has been found to shorten it. But, when the acids are added along with the inhibitors, a considerable increase in the

antioxidative activity is noted. This synergetic effect is particularly noticeable with oleic acid (Table II).

TABLE II

Synergetic effect of organic acids and inhibitors

Substrate Kathiawar Agmark Ghee

Inhibitor mixture %	Induction period* with inhibitor hours	Anti-oxidative index
0·2 Oleic acid +0·02 Hydroquinone ..	23	11·5
0·5 Oleic acid +0·02 Hydroquinone ..	36	18
0·2 Oleic acid +0·02 Kamala dye	78	39
0·5 Oleic acid +0·02 Kamala dye	>86	>43
0·5 Oleic acid +0·05 Kamala dye	>86	>43
0·02 Citric acid +0·02 Kamala dye	9	4·5
0·2 Citric acid +0·02 Kamala dye	19·5	9·75
0·02 Tartaric acid +0·02 Kamala dye	12	6
0·2 Tartaric acid +0·02 Kamala dye	26	13

* Induction period for control 2 hours.

This behaviour resembles that observed by Olcott and Mattil[2] who found that mixtures of orcinol and phosphoric acid prolong the period of induction in lard to a greater extent than either substance individually. It seems likely that the observation of Holmes, Corbet and Hartzler[7] on the superior stabilizing effect of combinations of lecithin and hydroquinone on vitamin A over that of either alone, is a case not dissimilar to the one recorded here. The advantages of using mixtures like oleic acid and Kamala instead of the abovementioned antioxidant mixtures of lecithin, phosphoric acid and other objectionable compounds are obvious.

The sample of Kamala dye was provided by Dr. S. Krishna, Biochemist, Forest Research Institute, Dehra Dun, to whom the authors' thanks are due.

[1] Banerjee, *Agric. & Livestock in India*, 1938, **8**, 153.
[2] Olcott and Mattil, *J. Amer. Chem. Soc.*, 1936, **58**, 2204.
[3] Rogers, *C.A.*, 1932, **26**, 613; *U.S. Patent*, **1**, 826, 258.
[4] Greenbank and Holmes, *Ind. Eng. Chem.*, 1934, **26**, 243.
[5] Eckey, *U.S. Patent*, **1**, 982, 907.
Richardson, Vibrans and Andrews, *C.A.*, 1935, **29**, 518, 2770.
[6] Bollman, *Ibid.*, 1923, **17**, 3234.
[7] Holmes, Corbet and Hartzler, *Ind., Eng. Chem.*, 1936, **28**, 133.

OBITUARY

Dr. Gopal Chandra Chakravarti

IT is with deep regret that we record the tragic and premature demise of Dr. Gopal Chandra Chakravarti—a former Lecturer in the Department of Organic Chemistry, *Indian Institute of Science*, Bangalore. He was practically bed-ridden since 1934 on account of paralytic attack and was staying in Calcutta. On 20th October 1939, he died of burns caused by an accidental fire in his bed chamber.

Born in June 1897, he was the son of Mr. Chandra Kumar Chakravarti. He took the B.Sc., B.A., M.Sc. and D.Sc. degrees of the Calcutta University with distinction. He was the recipient of a Silver Medal in 1921, Nagarjuna Gold Medal in 1924, and also a Premchand Roychand Scholarship. He was Demonstrator in Chemistry in St. Paul's College, Calcutta, 1920–21, Sir T. N. Palit Research Scholar in the University College of Science, Calcutta, 1921–24, and Professor of Chemistry, Serampore College, 1925–27. He joined the *Indian Institute of Science*, Bangalore, as a lecturer in 1927 and held that position till July 1934 when, for reasons of health, he had to resign from service.

Dr. Chakravarti's field of researches comprised both of synthetic chemistry and chemistry of natural products. His papers on the colour of complex diazoles and on sulphur-containing dyestuffs are of great interest. He studied the colouring constituents and the waxy product of the alkannet root and also suggested a constitutional formula for alkannin. His papers on mercaptans and thiophthalic acids deserve special mention.

Dr. Chakravarti was a devoted researcher. But for his ill-health he would have made still more valuable contributions to the science of chemistry.

B. H. IYER.

REVIEWS

Apes, Men and Morons. By Earnest Albert Hooton. (George Allen & Unwin, Ltd., London), 1938. Pp. 307 + viii. Price 10*sh.* 6*d.*

This is a collection of "reluctant addresses delivered at the instigation of persons or organisations" whose requests the author "dared not refuse". That the progress of man in the past has been bright and that "the tottering biped" is now faced with a dim prospect, is the main thesis of these discourses. While the traditional records of human achievement in the realms of material culture social institutions and human thought are recognised, the biological evolution of man has not kept pace with his other activities. The human improvement required is primarily biological and according to the author, we do not yet know how to effect it. The human race has to be freed from imbeciles and morons who are allowed to reproduce their kind, and to subsist upon the labours of others, from psychopaths who lead the mentally inferior mass of civilised populations into purposeless wars and social revolutions, from the ever increasing numbers of biological and mental inferiors who are antisocial and criminalistic.

The author in one of his addresses has made some "plain statements" about the question of race which has been bolstered up in many parts of the world as an excuse for the domination or persecution of "other" races. Each racial type runs the gamut from idiots and criminals to geniuses and statesman. No type produces a majority of individuals from either end of the scale. There are no racial monopolies of human virtues or vices.

In an address entitled "man as director of human evolution", the author has made specific suggestions concerning the necessity of an intelligent control of man's future evolution through medical science; that autodirective evolution appears possible for man alone. Studies on human inheritance should be inaugurated since these are essential for man's wise and efficient control of his own evolution. Such studies, according to the author, should commence with genetic researches upon the gross anatomy and general physiology of the human animal, his pathology, his psychology and mental capacity and should ultimately proceed to his sociability or fitness to function in human society. The future of mankind does not depend upon political or economic theory, nor yet upon measures of social amelioration, but upon the production of better minds in sounder bodies.

This is an extremely interesting book written in a provocative style; it has a topical interest. Humanity is now confronted with a terrible crisis. Political thinkers are planning a reconstruction of human society on lines which will avoid such catastrophies. A study of this volume may give a few important clues as to how this object may be achieved. M. S.

General Physiology. By Philip H. Mitchell. (McGraw-Hill Publishing Co., Ltd., London), 1938. Pp. xviii + 853. Price 36*sh.*

This is a third edition of the well-known publication, generally employed as a textbook for advanced study and instruction in colleges. The twenty-five chapters which comprise the volume, cover a wide variety of subjects and include illuminating chapters on physiology of contraction, reflexes and tropisms, physico-chemical structure of living matter, the permeability of membranes and living cells, catalysis and enzymes, the circulation of blood, respiration, physiological oxidations, excretion and protein metabolism, dietetics and vitamins, chemical regulation by internal secretions. The series of topics discussed in the volume and enumerated above, at once brings before our minds, the large dependence of physiology upon other fundamental sciences. In fact, the most spectacular achievements in physiology have been made through the application of the principles and the technique of the other sister sciences. Without the sensitive galvanometer, the refinements in spectroscopy, the delicate microbalance and scores of other instruments of precision, physiology would suffer a serious loss. Physiologists have always followed the lead of pure physicists and chemists.

For a true and proper appreciation of the principles and methods of general physiology, a thorough knowledge of the fundamental principles of physics, chemistry and physical chemistry is essential. These principles have

been cleverly woven into the topics under discussion. The chemistry of proteins, fats and carbohydrates, constituents essential to the metabolic activity, has been discussed in a chapter on the organic constituents of living matter. The physico-chemical principles governing surface action and osmotic pressure, have been presented with exceptional clarity and lucidity. The entire volume presents a very readable and interesting series of topics, which should interest not only the students of General Physiology, but also the physicists and chemists, who have the curiosity to understand and appreciate the interaction of fundamental sciences on the growth of general physiology.

M. S.

Atombau und Spektrallinien, Vol. II. By Arnold Sommerfeld. (Fried, Vieweg & Sohn, Braunschweiz), 1939. Pp. 820. Price 38 R.M.

This is the second edition of Professor Sommerfeld's well-known volume, which appeared in 1928, namely, the Wave-mechanical Supplement to his *Atomic Structure and Spectral Lines*. The present work is designated Vol. II instead of as a supplement to Vol. I. It has been revised and much enlarged from 352 pages to 820 pages, to include the rapid developments in the subject.

Subjects like uncertainty problems, transformation theory, and the influence of methods of measurement on the results of observations have been treated in Chapter III, only very briefly, as there are several other good books available, such as Heisenberg's *Physical Principles of Quantum Theory*, Dirac's *Quantum Mechanics*, Kramer's *Fundamentals of Quantum Theory*. On the other hand, the author has successfully developed the mathematical apparatus of wave mechanics according to the methods of the theory of functions and of algebra in a simple, lucid and original manner.

Great care has been bestowed on the handling of Dirac's relativistic theory of the electron. It has been given in the hypercomplex units, thereby avoiding the four-rowed matrices of Dirac. In an addenda, however, it has been shown that the Dirac matrices are a possible representation of these units. He has thus removed the difficulty caused by the arbitrariness that lay in the choice of the matrices and in the impossibility of correctly memorising them. Even the Spinor-theory has been successfully avoided, as shown in Chapter IV, by means of the Lorentz-transformations of the hypercomplex units in place of the Eigenfunctions (characteristic functions).

Problems of importance for experimental observations have been treated in detail. Separate chapters have been devoted to the photo-electric effect, the continuous X-ray spectra and the Compton effect, and in all cases their relativistic refinements have been explained in detail. The method used has been fundamentally treated in the chapter on the theory of perturbations.

The general theory of multiplets has not been taken up apparently for fear of making the book unnecessarily unwieldly. Only the origin of the doublets and their Zeeman-effects, on the Dirac theory have been completely developed. Dirac's theory of radiation and others, like the Briets' equation and Auger-effect, have had to be left out.

The very name of the author is enough commendation for the book. It is a pity that this book which is a result of about six years' labour of this great master has come out this year. Due to war conditions possibly only a few copies may be available outside of Germany.

B. DASANNACHARYA.

An Introduction to the Principles of Physical Chemistry. By O. Maass and E. W. R. Steacie. (New York: John Wiley & Sons; London: Messrs. Chapman & Hall, Ltd.), 1939. Second Edition. Pp. 395. Price 15*sh.* net.

The book is intended to provide an introductory course in physical chemistry for those who have had a prelminary training in elements of chemistry and physics and who intend either to make chemistry their profession or to take up a course in chemical engineering.

Physical chemistry plays an important role in the understanding of various chemical phenomena both in the laboratory and in industry. It is essential, therefore, that the student should possess an elementary knowledge of the various physico-chemical laws and relationships and have a clear concept of the fundamentals and their applications at a fairly early stage of his study of chemistry. The eighteen chapters in the book cover almost all that is desired to be communicated to a beginner in the

subject. The inclusion of new chapters on atomic structure, phase rule and colloidal chemistry is a decided improvement over the first edition and adds to the comprehensiveness of the book.

The subject-matter has been presented in simple language and as far as possible a good sequence between the theory and experimental work has been maintained. Modern conceptions and developments have been included wherever deemed necessary. Tables and illustrative diagrams have been provided in the text to make the subject easily intelligible. Questions and numerical examples given at the end of each chapter enhance the value of the book to students for whom it is intended.

The book is a good addition to the elementary treatises on Physical Chemistry and will be found useful by undergraduate students of Indian Universities.

MATA PRASAD.

Physical Constants of Hydrocarbons, Vol. 1. By Dr. Gustav Egloff. (American Chemical Society, Monograph Series, New York: Reinhold Publishing Corporation; London: Chapman & Hall, Ltd.), 1939. Pp. 403. Price $9·00 nett.

The increasing demand for hydrocarbon products has been responsible for the rapid rise of published matter on the subject. A critical digest of all data pertaining to physical constants of hydrocarbons is, therefore, an urgent necessity. This work has been undertaken by Dr. Gustav Egloff, Director of Research, *Universal Oil Products Company,* Chicago, and the first volume of the promised three volumes on the subject is now before us for review. It deals with physical constants of paraffins, olefins, acetylenes and other aliphatic hydrocarbons.

It would have considerably added to the value of this book if special uses and features of the hydrocarbons treated in the book were mentioned in the last column, namely, additional data, which is left blank in most cases. Some of these hydrocarbons can be shown to save special uses, for example, they can, by their presence, increase or decrease the cetene values, the anti-knock properties or the film strength of the oils used in industry. Their presence or absence produces gummy-resin forming tendencies and many other properties.

The get-up of the book is excellent and there are numerous references given at the end of each chapter. This book will be of particular use to all chemists, who are interested in petroleum products, as a reference book and every technical library should possess a copy of it.

S. S. BHATNAGAR.

A Practical Entomological Course for Students of Malariology. By P. J. Barraud. Second Edition; revised by I. M. Puri, *Health Bulletin* No. 18 (Delhi, Manager of Publications.) Pp. 143. Price Rs. 1–12–0.

The study of mosquitoes is becoming more and more complicated year by year and a practical malariologist has to be thoroughly conversant with the details of every one of its numerous aspects, before he can make any headway either in pure investigation or in malaria control. First, he must know how to identify the eggs, larvæ, pupæ and adults of the mosquitoes of his locality. This, to be thorough, requires a detailed knowledge of the minute morphology, especially so when one has to deal with subspecies and races. Secondly, he must be personally familiar with the methods of collection, transportation, rearing and preservation of mosquitoes. Thirdly, he must be well versed in laboratory technique such as rapid methods of dissections of salivary glands and midguts to determine the vector species and of conducting precipitin tests to determine feeding habits. Fourthly, he must have a general idea of the ecology, without which he will not be able to evaluate correctly, for purposes of control, the importance of species, of breeding and resting places, and of parasites and predators. Malariology has developed a rich and intensely practical technique in every one of these branches.

Most medical men who choose malariology for a profession start with very little knowledge of these subjects and even the average general entomologist is not fully aware of the wealth of theory and technique that has grown up in relation to the study of mosquitoes. To both these types of students, the work under review is very useful.

Primarily intended as a handbook for students who attend the annual malaria classes of the *Malaria Institute of India,* it has a great value to others also who may independently take up the study of mosquitoes or who may themselves have to train up other men. The subject-matter is arranged in the form of a series of fifteen lectures,

each lecture being followed by the related practical work, for which copious and pointed instructions are given. At the end of the book is a complete set of illustrations, a list of useful references and, not the least interesting, a full list of equipment needed. In this revised edition, Dr. Puri has brought all information up-to-date. An invaluable book to serve as an introduction to the practical study of mosquitoes.

T. RAMACHANDRA RAO.

The Fundamentals of Fruit Production. By V. R. Gardner, F. C. Bradford and H. D. Hooker, Jr. Second Edition. (McGraw-Hill Publishing Co., Ltd., New York), 1939. Pp. 788. Price 30/-.

The appearance of the second and enlarged edition of the work of the authors who have been pioneers in the field of pomology, clearly shows that it has met a definite need. In fact, a revised edition was long overdue as since the appearance of the first edition seventeen years ago, the science of fruit growing has made rapid strides. The new edition, therefore, will be doubly welcome to those interested in the fruit industry as also to students, research workers and teachers in Horticulture.

The revised edition like its predecessor is divided into seven sections with chapter headings which respectively discuss (*a*) water relations; (*b*) nutrition; (*c*) temperature relations of fruit plants; (*d*) pruning; (*e*) propagation; and (*f*) geographic influences in fruit production.

The second edition is not a mere re-printing of the first but contains a good deal of extra material. Although no new chapter has been added, it contains numerous valuable additions under sub-heads disseminated throughout the book. This clearly indicates that the subject-matter, in the light of recent researches, has been brought up-to-date. Considering the amazing amount of research, embracing a variety of problems important to fruit industry that has piled up during the last two decades, the task of sifting the published literature for inclusion in the new edition must have been, indeed, formidable. It is to the credit of the authors that the comprehensive nature of the work has made it possible to cover all aspects of the science of fruit growing in the manner they merit.

A noteworthy innovation in the book is the inclusion of a set of useful tables and figures numbering six and seven respectively. Twenty-seven tables chiefly from Section II, and two figures have been deleted as being unimportant and inappropriate. The addition of fresh information has also necessitated rearrangement of the subject-matter and modification of a few tables and numerous figures. This reshuffling has brought the subject-matter in proper sequence and rendered the interpretation of data clear and lucid. The bibliography at the end of each Section is greatly enlarged particularly in Sections I, II, V and VI. The list of references for collateral reading, on the other hand, is reduced, at the same time a few fresh references are included. In Section VI, however, an altogether fresh list is substituted for the original. The glossary is also enlarged. The addition of fresh matter is so great that the new edition is larger by more than hundred pages.

Of serious errors there are none but a few minor ones have unfortunately escaped the attention of the editors. In many cases chapter heads and sub-heads have not been tabled in the contents in strict accordance with the text. A few sub-heads have altogether been omitted in the table of contents. As in the first edition, the conspicuous omission is the summary at the end of Chapters XI, XXI and XXXII. Further, on page 176 under "Factors of Carbon Assimilation", the factor of "Nutrient Supply" discussed on page 181 is not included. In a few cases the scale of temperature employed has not been indicated against the temperatures—as on page 381 and in tables 38, 57 and 60 on pages 335, 389 and 393 respectively. The spelling of the word "sulphur" is not consistent. On pages 115, 226, 762, 763 and 764, it is spelt as "sulfur" while at many places it is "sulphur".

The list of references for collateral reading ought to have been arranged alphabetically according to the authors and serially numbered to bring it into uniformity with the bibliography which follows.

The book is conspicuous by its absence of references to recent researches on (1) Plant Hormones and (2) Hydroponics—the science of crop production in liquid culture media both of which are now important subjects for research. Particularly, the use of plant hormones—natural or synthetic, is widely advocated in nursery practice. Therefore, it is believed that it would have been within the scope of this useful book to have devoted

a chapter each on the practical application of Plant Hormones and Hydroponics in fruit growing.

The second edition, as a whole, is comprehensive and clearly written and, therefore, to a practical grower its value is obvious. The student and research worker will also find in it much that is useful.

I. A. SAYED.

The Raman Effect

The Raman Effect and Its Chemical Applications. By James H. Hibben. (American Chemical Society, Monograph Series No. 80. New York: The Reinhold Publishing Corporation; London: Chapman and Hall, Ltd.), 1939. Pp. 544. Price $11 or 66/-.

DURING the comparatively short period of a little over ten years that has elapsed since the discovery of the Raman effect, a vast amount of literature has grown around the subject. Over two thousand publications have appeared during this period and the subject has been pursued in the research laboratories of practically every nation in the world. A notable feature which characterises this vast literature is the diversity of topics which it covers. The fundamental nature of the discovery and the powerful weapon which its application provides for a study of several scientific problems has undoubtedly been responsible for such a state of affairs. A book writer in this subject is, therefore, confronted with peculiar difficulties. He is not only called upon to critically deal with an incredibly large mass of data but has also to present a comprehensive account of its several applications dealing with apparently very different branches of physical and chemical sciences, if his work is to do justice to the subject.

The book under review is written with special emphasis on the chemical applications by one who has himself done a considerable amount of work in that direction. It consists of three parts, namely, I. A General Discussion of the Raman Effect: Its Practice and its Theory; II. The Raman Spectra of Organic Compounds; and III. The Raman Spectra of Inorganic Compounds. A comprehensive bibliography and an elaborate index are given at the end.

An excellent account of the available experimental methods is given in Part I. The theoretical aspects of the subject with special reference to the normal vibrations of polyatomic molecules are also dealt with in an elementary manner in this Part. The mathematical detail has been skipped over in a number of places and rightly too as the presentation of such detail would not only have been out of place but would also have unduly increased the size of the book. In the present form, Part I serves as a very useful introduction to a reader who wishes to make a detailed study of these aspects.

Consistent with the title of the book, three quarters of the matter is, however, contained under Parts II and III. In these Parts, the subject of molecular constitution is the dominating feature. Several other aspects such as isomerism of different kinds, free rotation, electrolysis, polymerization, etc., have been adequately dealt with in appropriate places. An alternative arrangement would have been to deal with these important phenomena under separate headings but, as the author himself says, there are certainly several different arrangements possible for the presentation of such a vast amount of material in the chemical field and it is not right to adhere too closely to any one method or criticise too strongly any other. A discussion of the Raman spectrum of benzene in relation to its constitution is contained in Part II. Amongst other notable sections in this part, mention may be made of the one dealing with terpenes and their derivatives. Part III, in particular, contains a full description of the Raman spectra of several simple substances such as some gases, phosphorus, sulphur, carbon, water, inorganic acids, etc., which forms the basis for a thorough understanding and appreciation of the various constitutional problems.

One great point about this book is the fact that it contains an up-to-date and exhaustive collection of experimental results so far obtained in the subject of Raman spectra and hence it is bound to be of immense help as a book of reference to all research workers in this subject. With the help of the bibliography and the index given at the end of the book, references to original papers are easily obtained by one who desires to get more detailed information on any of its particular aspects. As such, it fills up a long-felt void and will be welcome in many quarters.

S. BHAGAVANTAM.

CENTENARIES

Barlow, Edward (1639–1719)

EDWARD BARLOW, a British priest by profession but a mathematician and inventor by nature, was born at Warrington, Lancashire, in December 1639. He had his education at the English college at Lisbon and after being ordained priest, his chief employment was attending the poor "to whom he conformed himself both in dress and diet".

Invents Repeating Clocks

Barlow invented repeating clocks in 1676 and repeating watches a few years later. On a string being pulled, clocks were made to indicate the hour or quarter which was last struck. But in a contest with another inventor, Quare, the King preferred to give the patent to the latter.

Barlow's Versatility

Barlow had been described as a master of the Latin and Greek languages and as having had a competent knowledge of Hebrew. "Tho' he read not many books of that kind, the whole system of natural causes seemed to be lodged within him from his first use of reason. .... At his first perusing of Euclid, that author was as easy to him as a newspaper."

His Works

Barlow was the author of :—

(1) *Meteorological essays concerning the origin of springs, generation of rain, and production of wind; with an essay on the tide*; 1715.

(2) *An exact survey of the tide: explicating its production and propagation, variety and anomaly, in all parts of the world, especially near the coasts of Great Britain and Ireland, etc.*; 1717.

(3) *A treatise on the Eucharist.* 3 v.

The second of these went through a posthumous second edition.

Barlow died in 1719.

Wigan, John (1696–1739)

JOHN WIGAN, a British physician, was born at Kensington, January 31, 1696. He had education successively at Westminster school and Christ Church College, Oxford. He became M.D. in 1727 and a fellow of the College of Physicians in 1732. Having been principal of New Inn Hall, Oxford, and secretary to the Chancellor of the University from 1726 to 1732, Wigan settled in London as physician to Westminster Hospital. He retained this office till 1738 when he went to Jamaica as physician and secretary to Sir Edward Trelawny.

His Works

As early as 1718 Wigan published a translation of a treatise on the cure of fevers from Longinus's *De Curandis Febrius continuis Liber.* In 1723 he brought out a splendid folio edition of Aretaeus. He also edited the *Opera omnia medica* of Dr. Friend in 1733. He also wrote Friend's biography and translated his *History of physick.*

Wigan died in Jamaica, December 5, 1739.

Winchell, Newton Horace (1839–1914)

NEWTON HORACE WINCHELL, an American geologist, was born in Northeast, Dutchess Coutry, New York, December 17, 1839. Having had his early education in the local schools, he became a teacher at the age of sixteen. From 1855 to 1869 he was alternating between studying in the University of Michigan and teaching in schools. Thereafter having been an assistant in two state geological surveys, he finally settled down as the state geologist of Minnesota in 1872 and held the position till 1900 when the survey of the State was finished. From 1874 he also held the professorship of geology in the University of Minnesota. During the last eight years of his life he was in charge of the Department of Archæology of the Minnesota Historical Society.

His Works

As state geologist, Winchell published annual reports from 1872 to 1898. These reports, ranging from pamphlets to volumes of five hundred pages, taken along with the ten bulletins and six quartoes published as extra volumes, covered the geology of the State exhaustively. His *Aborigines of Minnesota* (1911) gave a similar exhaustive account of about 10,000 Indian mounds and constituted a regular encyclopædia of the anthropology of Red Indians.

Post-Glacial Time

Winchell's many detailed observations and discoveries relating to the conditions of formation of the drift deposits and the sequence of events in the Ice Age were interpreted with a clearness and logic that have rendered them a substantial contribution to our knowledge of the glacial period. His description and discussion of *The drift deposits of the northwest* in 1873 contained a prophetic pronouncement, which was confirmed by actual field work some twenty years later. He estimated the duration of post-glacial time as lying between 7,000 and 8,000 years. This is regarded as his greatest service to glacial geology.

Antiquity of Man in America

Winchell's field examination and long deliberation led him to publish in 1902 a memoir of 16 pages establishing that man existed in America in the Ice Age. This subject continued to engage his attention throughout the rest of his life. In fact, his last paper entitled *Antiquity of man in America compared with Europe* was delivered as a lecture before the Iowa Academy of Sciences a week before his death.

General Activities

Winchell was one of the founders of the Minnesota Academy of Sciences and of the geological Society of America of which he became president in 1902. He was also the founder of the *American geologist,* the first geological periodical of America.

Winchell died at Minneapolis, May 2, 1914.

S. R. Ranganathan,
University Library,
Madras.

Film Reactions as a New Approach to Biology*

THE colloidal properties of living matter are due to the fact that an exceptionally large fraction both of material and of energy is present in films, membranes, fibres, fine capillaries, and the like. In his presidential address to the Chemistry Section Prof. E. K. Rideal has re-emphasised the importance of the fundamental concepts introduced by Sir William Hardy and Dr. I. Langmuir as to the structure of matter in this boundary state. Many of the modes and types of reactions which can be effected in monolayers, and which can be defined with precision, and their mechanism established with a considerable degree of assurance, are unique for such interphases but are again observed in living and organised material. Many 'vitalistic' models have been proposed in the past, and whilst it might be correct, although unscientific, to suggest that the ultimate level of integration in living matter is incapable of examination and definition, yet one is justified in asserting that at least one of the important levels to which due attention must be given for a proper understanding of biological activities is that of the ordered interface.

Besides the static properties such as form, composition, and orientation, that must be studied, the dynamic properties of ingress and egress of flow and chemical action in and with the two dimentional contents of the phase are particularly significant. From the works of W. Gibbs, Hardy and others, a great deal is known about how the composition of the interphase differs from that of either of the bulk phases in contact with it, as also how the molecules contained in a monolayer are oriented with respect to one another and to the plane of the interphase. However it is to be noted that as compared with monolayers of simple molecules such as derivatives of both paraffinic and cyclic hydrocarbons, the monolayers both of macromolecules as well as those of binary and components of a higher order, possess a number of interesting and somewhat unexpected properties. The chains are extended at the interface and in general, the non-polar side-chains penetrate into one (the non-polar) and the polar side chains into the other (the aqueous) phase. This relative orientation can be altered by extension or compression. If the molecules in the monolayer undergo reaction with a reactant dissolved in the substrate, the rate of reaction may be modified by the change in the molecular orientation of the former. (It is interesting to note in this connection that these film reactions can be carried out with minute concentrations of strongly absorbed reactants, sometimes even as low as $2{\cdot}5 \times 10^{-6}$ per cent. as in the case of attack of lecithin by snake venom.) There are also several processes in which an alteration in the properties of an interphase brings about a number of varied biological processes of great importance such as phenomena of lysis, agglutination, sensitisation, and the lethal activities of certain substances on various types of cells and micro-organisms.

In two component layers the two molecular species are adlineated in respect to one another, and it should be possible to form relatively stable two component complexes which in three dimensions would only be detectable in terms of mutual solubility and which when a mutual solvent is present as a third component might not be observable at all. Indeed strong complexes are formed in mixed monolayers of a variety of substances such as saponin with cholesterol or digitonin or cetyl amine or sulphate with cholesterol.

From the biological point of view the most interesting property of these systems lies in the mechanism of their formation, for on injection of one of the reactants beneath a monolayer of the other, it is found that a penetration of the latter by the former will take place first and then the formation of a complex monolayer by adlineation. Some substances such as digitonin or cetyl sulphate or amine possess remarkable reactivity in respect to penetration of monolayers of cholesterol. Other substances such as sodium oleate, cetyl sulphate, or psychosin, when injected beneath a protein monolayer, disperse it on account of their stronger associating reaction and cause a solution of the protein in the form of a protein-reactant complex.

By spreading monolayers with various head groups and examining reactions caused on injection, it is possible to identify the reacting group in the protein layer. A characteristic group of protein complexes formed in monolayers are the lipo-proteins, such as the gliadin-cholesterol complex. In the latter, the cholesterol is anchored to the specific amino and carboxylic groups in gliadin. These penetrative reactions not only involve a new head group interaction but, in many cases, also a breaking of such a head group interaction already existing in the monolayer prior to penetration. Thus lysis of blood cells can be brought about both by protein and cholesterol, and one must hence conclude that it has a lipo-protein surface.

In the case of reactants containing two or more head groups multiple point contacts are made, and the hydrophobic portions can, if possible, pack or adlineate with its neighbours beneath the monolayer, resulting in a composite film of remarkable stability.

A wide variety of substances have been examined for their extent of interaction with protein monolayers and it has been found that there is a direct parallelism between their extent of interaction and their lethal action on paramœcia. The most reactive group in the protein macro molecule is the amino group, the others following in the order

$$\overset{+}{\mathrm{RNH_3}} > \mathrm{RSO_4'} > \mathrm{RSO_3'} > \mathrm{RCOO'} > \overset{+}{\mathrm{RN(CH_3)_3}} > \overset{+}{\mathrm{RNH(CH_3)_2}} > \text{Bile acids.}$$

As regards the hydrophobic portion, biological activity and film penetration commences with

* Summary of the Presidential Address by Prof. E. K. Rideal, M.B.E., F.R.S.—Section B—Chemistry—British Association for the Advancement of Science, Dundee, 1939.

C_9 when attached to a very reactive head group, with C_{10} when attached to a poorly reactive group, and reaches a maximum value at about C_{18}. It is interesting to note that it is not necessary for all the carbon atoms to be in the form of a chain but may be enclosed in ring systems.

One can see, therefore, that the Overton Meyer or Traube concepts of biological activity, *i.e.*, lipoid solubility or capillary activity must be modified by the introduction of concepts of specific head group interactions. A study of these reactions, further permits us to investigate the nature of the coatings of cells or unicellular animals and plants, by examining the effects of lipoid or protein penetrating substances on them.

This extremely interesting address of Prof. Rideal closes with a brief discussion of the possible sources of the bioelectric potentials observed in tissues.

M. A. G. RAU.

MAGNETIC NOTES FOR NOVEMER 1939

MAGNETIC CONDITIONS.—The magnetic conditions during the month of November 1939 were quieter than those during the previous month. There were 19 days of *slight* disturbance and 1 day of *moderate* disturbance. No days of great or very great disturbance were recorded during the month. The number of quiet days was 10.

The quietest day during the month was the 22nd and the most disturbed day, the 13th. The actual characters of individual days is shown in the table below.

Magnetic Storms.—During the month a *moderate* storm was recorded on the 13th. This was the only storm recorded during the month as against three *moderate* storms recorded during the corresponding period in 1938.

Dates of the month	Quiet days	Disturbed days	
		Slight	Moderate
1939 November	2 to 8, 10, 16, 22.	1, 9, 11, 12, 14, 15, 17 to 21, 23 to 30.	13

Monthly Characters.—The mean character for the month of November 1939 is 0·70 as against 1·03 for November of last year.

M. R. RANGASWAMI.

Tambyacha Bungla,
Colaba, Bombay 5,
December 6, 1939.

ASTRONOMICAL NOTES

Planets during January 1940.—Mercury will be visible as a morning star for a few days in the beginning of the month and on January 31, will be in superior conjunction with the sun. Venus, moving slowly eastwards relatively to the sun, will continue to be a bright object in the western sky soon after sunset. Mars and Jupiter can be seen to the west of the meridian in the early part of the night. There will be a close conjunction of the two planets on January 7, the angular distance between the two, at the time being about a degree. Mars continues to get fainter, the stellar magnitude being 1·1 (nearly the same as that of Antares) at the end of the month.

Saturn resumes its slow eastward motion among the stars; on January 16, it will be in quadrature with the sun and will still be an interesting object for observation. Uranus has a retrograde motion in the constellation Aries, until January 26 when it becomes stationary. The planet reaches the meridian at about 7·30 p.m. and can be seen very near the fourth magnitude star δ Arietis. Conjunctions of the moon with planets will occur as follows:—Mars and Jupiter on January 16, Saturn on January 17 and Uranus on January 19.

Comets.—Information has been received (*U.A.I. circ.* 797) of the re-discovery of Periodic Comet Giacobini—Zinner, on October 15, by Prof. Van Biesbroeck at the Yerkes Observatory. It was a faint diffuse object at the time (magnitude 15), but as it is getting nearer the earth and the sun, it is likely to become bright enough to be seen with moderate optical aid. The comet is due to pass perihelion on 1940 February 17, the computed period being 6·59 years.

T. P. B.

The Interpretation of Plant Structure*

EARLY botanists had to turn their attention to systematic morphology and classification in the first instance. The anatomists were content with describing the facts of internal structure and systematising them.

The "Origin of Species" gave a new impetus for research and the tendency for the interpretation of structure in terms of adaptation to function or of phylogeny became more marked. It is a point for careful consideration whether such exaggerated emphasis on adaptation or phylogeny is justified in the light of modern research.

To take the adaptation outlook first, the structural features of xerophytes are usually regarded as an adaptation for reducing transpiration with little experimental evidence in support of it. Several xeromorphic plants there are which are found to be transpiring vigorously. For a correct interpretation of structure in terms of adaptation it is necessary to have an exact knowledge of the quantitative relations of the different functions to the environment.

So far as quantitative investigations go, the case for adaptation in the case of xerophytes is not very strong. The assumption that xerophytes have fewer stomata is shown by Zelenski to be erroneous. It is found that the leaves of plants growing in dry conditions may show a higher stomatal frequency. Statistical studies of Salisbury show that the proportion of stomata to epidermal cells is more constant over a range of moisture conditions than stomatal frequency which is determined primarily by conditions at the time of the development of the leaf primordium. While the number of stomata is determined by the internal make-up, the frequency of stomata is influenced by the water supply to the leaf in the subsequent phase of expansion during development. The better the water supply to the leaf, the farther apart are the stomata. Hence an interpretation of stomatal distribution in terms of adaptation is not justified.

Another instance of quantitative approach of the problem of adaptation is the correlation between the dimensions of parts and the tissues serving them. A correlation may also be observed between two different organs. An increase in the foliage involves an increase in the amount of conducting tissue. Bower's studies on the relation between scale and complexity are undoubtedly interesting. The functional interpretation of correlations will appear to be far-fetched. Attention should be directed to the study of the casual aspect so that correlations may be correctly interpreted.

The present-day knowledge of chemical agents or hormones such as auxins, throws a flood of light upon the development of plant organs including correlations. One-fifty-millionth of a milligram of auxin produces a measurable effect on the oat coleoptile. The influence of auxins on the dormancy of lateral buds, the dependence of cambial activity of the stem on the basipetal conduction of auxins from the developing buds above, the change from the vegetative phase to the flowering phase through the diffusion of special substances and so on are facts of no ordinary significance. There are again the organ-forming substances of Went, whose movements are influenced by auxins. "The demonstration that such hormones exist and are effective in influencing plant development is of far-reaching significance. It is a challenge to students of plant structure to view their data dynamically."

Now for the phyletic outlook. It has been the aim of evolutionists to construct a geneological tree of plants. The phyletic outlook came into prominence as the result of the remarkable studies of palæobotanists. Is similarity always an indication of relationship? In the evolution of plants through ages, several features are commonly observed in a number of unrelated groups of plants. The alternation of generations, the ventilating system of land plants and stomata, the archegonia, the formation of spores in tetrads following reduction division, and the cell structure and organisation are not to be treated as haphazard. Are these resemblances to have phyletic significance? Cannot these features have originated independently in different groups? This similarity or parallelism in the organic world extends also to chemical substances as, for instance, the enzymes in the yeast and higher plants and the presence of chlorophyll and hæmoglobin in plants and animals respectively.

The idea of F. F. Blackman that the biologically important carbohydrates are just those which are chemically most likely to arise can have a wider application. Why should the appearance of chlorophyll or even of living substance be taken to be unique? It is probable that the ground has been prepared for them beforehand through the evolution of a system that could produce chlorophyll, one derived presumably from a pre-existing system capable of producing pyrrol and hæmin compounds. The nature of the major changes in the pageant of evolution of plants can be better understood if one could have a knowledge of the laws of harmonious development.

The phyletic approach is apt to be misleading. The woodiness of the lower portion of herbaceous plants is regarded as a recapitulation of the presumed phylogenetic sequence in ontogeny. But the fundamental features of the development of stem structure are identical at all levels and the difference that is noticed can be easily explained.

Another instance of phyletic approach of a problem is the interpretation of seedling structure. On the analogy of the stelar structure as revealed by the fern sporeling and the fern stem, one school of botanists holds the view that the seedling structure is a recapitulation of the changes in the structure of the stele. The exarch xylem of the root is seen to extend to the hypocotyl and to even cotyledons in some cases. Can the peculiarities

* Summary of the Presidential Address by Prof. D. Thoday, sc.d.—Section K—Botany—British Association for the Advancement of Science, Dundee, 1939.

noticed in the change from root structure to stem structure in the hypocotyl have a phyletic significance?

An interesting point that has come up for discussion in this connection is the nature of the seedling axis. The phyletic-minded school considers the seedling axis as nothing but a unity of which the root forms a specialised part. But Bugnon has advanced the view that *the root and the shoot are two distinct and well-defined categories of plant members each with the power of self-determination.*

The power of self-determination of root was demonstrated by means of experiments with root tips cut off from the plant. The tips continued to grow continuously for years in nutritive solutions containing sugar, essential salts and an extract of yeast. The development of the root is normal in the case of tomato, wheat, pea and maize. Kotte found that the tips of roots cut obliquely or longitudinally were able to form complete roots. It is interesting to note that secondary thickening fails to take place in dicot roots in these experiments.

The shoot is the other self-determining but dominant centre of development. It controls the polarity of the shoot and also the primary and secondary development of the stem below.

"At two ends of a short meristematic axis are two self-determining centres of different kinds in close proximity, two opposite poles, a shoot pole and a root pole, each of which is capable of impressing its own inherent pattern on the meristematic tissues to which it gives rise. Under these conditions we cannot assume that the spheres of influence of each will be sharply defined, nor that they will be necessarily fixed. If the influence of the poles depends upon hormones emanating from them, the boundary might well change with changes in the relative vigour of the two organising centres and differ also from one species to another." The case for the application of recapitulation theory to plants is undoubtedly weak. M. S. S.

Natural Geographic Regions

THE most prominent concept in the British Geographical thought is that of Natural regions. Instead of limiting the term *Natural Region* to physical and inorganic aspects and *Geographic Region* to economic and human aspects, if we define the term Natural Geographic region clearly it forms the foundation of all Geographical thoughts. Herbertson's concept of Natural regions reveals the idea to be a conceit rather than a concept; for instead of inquiring where the new concept leads, he contented himself with analogies. His major natural regions were essentially climatic regions. Roxby in 1927 associated the course of human development with natural regions. With this idea is associated the normal conceptions of inevitableness and universality. The French and German Schools of thought converged with the ideas of Herbertson.

Most of the writers delete the word 'Geographical' from the term. According to Roxby a natural region is characterized by a particular set of physical conditions. But in a large area it is hard to find a uniform set of conditions. So, it is better to choose a 'dominant' physical character for larger areas as the criterion. But the view of Herbertson that climates are the 'dominant' characters evoked a lot of criticism. A systematic study is essential before establishing the dominance of physical conditions. The idea that a natural region is a physical entity and that the different regions have no definite boundaries appears to be an unnatural one.

The usual method of regional treatment in orderly succession starting from Geological structure and ending in a description of human matter has no principle of selection and constitutes merely a jumbling of information. Some Geographers insist on the method of Geographical study by synthesis. Unstead like Herbertson distinguishes orders of Natural region as its immediate environment, because it is a Natural growth limited by geographical circumstances. This is formed from a synthesis of all the countries and is peculiar to Europe. Physical conditions are neither more permanent nor more fundamental in Geography than the 'Human'.

The study of the Natural Geographical regions in this wider sense contributes to the human regions and he assumed that these orders could be further subdivided into 'stows'. Considering 'stows' as physical units, he builds up larger regions; but mere addition of physical units indicates the absence of cohesion in Geographical accounts thereby rendering 'synthesis' an impracticable study.

Synthesis is not merely an addition but is a complex process involving man's relationship with his environment. Hence a Natural Geographical region is a result of Synthesis proceeding in nature under our eyes but not by our voluntary action. The synthetic product has two aspects, *viz.*, the Environmental aspect, and the Human or Functional aspect. The first constitutes the Region and the second the Community. Hence, the term 'Natural Geographical region' must take both into account; if not it ceases to be Geographical.

The unity of the Natural Geographical region is achieved, maintained and developed by organisation, and this cohesion is attained and extended by intercourse, at first within, and later beyond the region, provided the organic development is an indigenous growth. There are minimum and maximum sizes for natural regions. The minimum is determined by the least extensive area capable of being developed and organised. The maximum is determined by the efficiency and range of means of communication. Both these vary in time. The organisations could be classified as 'conscious' and 'self conscious' depending on the objective view of man and its source in his nature. Natural

* Summary of the Presidential Address by Mr. A. Stevans—Section E—Geography—British Association for the Advancement of Science, Dundee. 1939.

regions could be distinguished as of continuous and discontinuous development depending upon the changes in human life.

What is fundamental in consideration is not the difference of Topographic fragmentation but the relativity to man. By this conception, it is seen that the Natural Geographical region is an active organism which is controlled by the technical development of the people and the means of communication.

The European Nation-State is an organic phenomenon occupying a Natural Geographic well-being. For the development of Geography, the consideration of Historical Geography is important. The territorial developments of European States culminated before the War, but are now readjusting. From a study of living Geographical entities, the Geographer can offer suggestions on practical politics and help the development of National future. B. V.

Metamorphism and Igneous Action*

IN 1833, Lyell introduced the term "Metamorphism" to indicate rock transformation and, from the beginning, he considered that metamorphism was closely connected with some kind of igneous activity. In the development of ideas on metamorphism since Lyell's time, emphasis has been laid upon the dominance of one physical factor or other in rock transformation as seen in expressions dynamic metamorphism and thermal metamorphism; or on spatial considerations as in regional or local metamorphism. The term "metamorphism" is extended by some to include weathering and cementation; and contracted by others to exclude simple crushing. Recrystallisation is regarded as an essential in metamorphism by one school, and as not requisite by another. According to one group of geologists the chemical composition of rocks undergoing metamorphism is not changed; and according to another it can change to any extent.

This diversity of opinion is due to certain fundamental and human causes. It arises mostly from a generalisation of ideas based on experiences confined to limited regions, to cover the whole field of metamorphism. Localised experiences from several regions led to different schools of thought which were, more or less, nationalistic in character. The following brief review of the tenets held by these different national schools will indicate the lines of development of metamorphic geology.

In Germany, Rosenbusch, from his study of contact metamorphism around the Barr-Andlau granite, in 1877, found no evidence for transfer of material from the intrusive granite into the surrounding country; and applied his conclusion from that study to all granitic contacts, laying down that permeation by magmatic juices was impossible. Lehmann (1884) and others from their study of gneissic rocks held the view that gneisses were formed by movement, and termed this mode of alteration "dislocation metamorphism", which was called later by Rosenbusch, dynamic metamorphism. Therefore for the older German School of geologists, there were two kinds of metamorphism—contact metamorphism of a local character surrounding igneous intrusions, and dynamic metamorphism extending over very large areas resulting from pressure consequent on earth movements. Some of the German geologists, however, during the first decade of the present century, described many examples of transference of material, and cases of injection and assimilation at granitic contacts.

In France, a powerful school had developed with tenets completely opposed to those of Rosenbusch. From their studies, during 1880–1900, of different granitic contacts, the French School of geologists concluded that the country rocks adjacent to the advancing magma had been changed in chemical composition by mineralising agents and granitised. The original granite magma combined with the country rock either by permeation or by *lit-par-lit* injection; and it advanced by the conversion of its country rock into granitic material and incorporating it in the main moving magma. Granitisation or felspathisation was established, by this School, as a petrogenetic process.

Many of the products of these injections and granitisation processes were foliated or gneissose in structure. According to the French School, therefore, gneisses were not the result of a dynamic metamorphism as the German geologists believed, but resulted from the injection of magmatic material.

Termier, however, though a bitter opponent of dynamic metamorphism, expressed his views on the processes of metamorphism somewhat different to those of his countrymen. According to him, the causative factor of metamorphism was the coming from depths of juvenile liquids, when the temperature of the geo-synclinal sediments increased rapidly leading to the solution of the eutectic mixtures. True magmas were formed, here and there, of all dimensions, increasing with the depth; in the upper parts, the geo-synclinal sediments were recrystallised without any change of chemical composition and passed downwards into gneisses, and upwards and laterally into less metamorphic rocks; the still liquid "magmatic portion" was intruded at higher levels in cross-cutting form. Therefore, according to him, regional metamorphism was not caused by igneous intrusion. Both regional metamorphism and igneous intrusion occurred together as different effects of the same cause—the rise of the *Colonnes filtrantes* or juvenile liquids.

In Austria and Switzerland, the study of metamorphic rocks led to the elaboration of ideas relating to directed pressure and the influence of depth factor in metamorphism. This School of geologists hold that due to difference in temperature, pressure and such other physical

* Summary of the Presidential Address by Prof. H. H. Read, D.Sc., F.R.S.—Section C—Geology—British Association for the Advancement of Science, Dundee, 1939.

factors in vertical column of depth, groups of minerals of varying physical characters are produced, by metamorphism, in different zones. The classification of such zones and the groups of minerals which would be formed in each of them have been the subjects of elaborate study by Becke of Vienna, Heim, Grubenmann and Niggli of Zurich.

In Scandinavia, important contributions were being made to the study of metamorphism. Sederholm, in Finland, by a series of extended investigations on several granitic contacts expressed his views that the granitic magma by processes of penetration and injection, in which the magmatic juices or *ichors* played a large part, mixed with the country rocks to give rise to a great variety of composite or mixed rocks, —the migmatites. Re-fusion or re-solution was effected by emanations from abyssal magma, giving rise to secondary magmas capable of intruding into their surrounding rocks. In America, up to the period of the Great World War, two schools of thought had developed; the one led by Lindgren and other mining geologists demonstrating transfer of material at igneous contacts, and the other dealing with injection metamorphism and granitisation after the manner of the Scandinavian and French schools.

In Britain, Judd (1889) proposed his term "static metamorphism" to cover those changes resulting from pressure due to the weight of superincumbent load, and not to movements in rock mass. This idea was elaborated by various geologists in Europe and America. Horne, Greenly, Barrow and several others have examined the metamorphic areas and described the processes and effects resulting from granitic intrusions.

There is no uniformity in the classification and definition of rock transformations. For instance, one dichotomy is based on space, as in regional and local metamorphism, another on mechanics as in static and dynamic metamorphism, a third on geological considerations as in Grundgebirge and Deckgebirge metamorphism and so forth.

Regional metamorphism, meaning rock transformation affecting over extensive areas, has been ascribed to different processes. Some geologists require that regionally metamorphosed rocks should arise by the action of hot emanations on deeply buried rocks; and others including Rosenbusch, Holmquist, and Teall and Flett of the British school, use that term as equivalent to dynamic metamorphism; Harker considers that the essential of regional metamorphism is a conjunction of high temperature and intense shearing; and still others such as Giekie, Kemp and Clarke maintain that the definition should state clearly that the transformation was not connected with igneous activity.

Prof. Read interpreting "regional metamorphism" in its real sense, to mean "a transformation that has affected large portions of the earth's crust" discusses his views on the processes which have brought such transformation.

He considers that the effects of dynamic metamorphism in producing rock transformation on a large scale has been exaggerated. The idea of higher grade metamorphism being produced under enormous load is also negatived. From evidences found in several regions showing the preservation of original rock structures such as current bedding, graded bedding, varved bedding, etc., in completely recrystallised sediments and the obliteration of such structures in low grade metamorphosed rocks it is argued that there is no need to assume great depths for regional metamorphism. On the contrary, Prof. Read considers that high grade regionally metamorphosed rocks must have been formed in many areas under relatively little cover.

Prof. Read discusses in the later part of the address the various aspects of granitisation, —the sequence of the processes of replacement, introduction of magmatic material, migmatisation, metasomatism and the formation of "parts" of chemical individuality, etc. He is inclined to divide all rock transformations into two groups; one, those of dislocation metamorphism associated with dislocation of the crust, and the other, those of regional and thermal metamorphism associated with igneous activities.

World's Most Powerful Magnet

THE *Institute of Physical Problems*, in Moscow, possesses the most powerful magnet in the world.

For obtaining superstrong magnetic fields, Prof. P. L. Kapitza employs a solenoid, through which a strong current passes for a few hundredths part of a second. At this instant a superstrong magnetic field arises in the solenoid which due to the shortness of the time does not become warm. Kapitza worked out a special type of storage battery for his first experiments; it could be charged in the course of a few minutes and then short-circuited through the solenoid. At the moment of the short circuit, a current up to 7,000 amperes could be obtained, producing a magnetic field up to 80,000 gauss.

Later, Kapitza replaced the storage batteries by a powerful alternating current generator. His rotor revolves at a speed of 2,000 r.p.m. The slacking up, which takes place during an infinitesimal fraction of a second produces a shock like a miniature earthquake.

In the beginning, Kapitza was confronted by great difficulties arising in connection with the construction of the coil of solenoid. During a short circuit, tremendous radial forces would arise in the coil and break it. Kapitza turned to theoretical calculations and worked out a satisfactory design for the coil. With its use, it has now been possible to induce magnetic fields of a force as yet not attained anywhere else in the world—325,000 gauss. (*Sovietland*, 1939, 8, 18.)

SCIENCE NOTES AND NEWS

Chief Racial Types of India.—Thirty bronze heads, representing the chief racial types found in India, have been purchased by the Government of India, for the Ethnographical Gallery of the *Indian Museum*, Calcutta, from Mrs. Marguerite Milward, a distinguished sculptress and pupil of Bourdelle.

The figures, which enable visitors to form a correct picture of the main races of India, have for the present been placed in the western end of the Gallery, but will shortly be displayed on pedestals where they will get full advantage of light and provide an additional attraction.

The sculptured heads are made from living individuals selected for Mrs. Milward by anthropologists and local officers belonging to the Government of India and the Indian States, who are intimately acquainted with the different tribes and know their peculiar somatic features.

Besides being works of high artistic excellence, the heads are illustrative of the somatic peculiarities of the different tribes with an exactitude of details which it is difficult to surpass. Among these there are the busts of a Negrito Kadar with his frizzly Melanesian hair, fair representatives of the Proto-Australoid group such as the Santals, Mundas, Maria Gonds and the Chenchus of Hyderabad, representatives of the Mangoloid tribes of the sub-Himalayan region and Assam, such as the Tibetan and the Lepcha of Sikkim, the Abor and the Mishmi from the extreme northern frontiers of Assam and the Angami and the Konyak Nagas of the Naga Hills. The busts also include the head of a Toda of the Nilgiri Hills and a Bengali Brahmin of a well-known family of Calcutta.

* * *

Oxides of the Transition Metals.—Among the several interesting properties of the transition metals and their salts, the non-stoichiometric decomposition of their oxides (*i.e.*, Mn and Cr) presents an intriguing problem. The magnetic properties of these compounds provide a convenient method of study, but show such wide variations in the case of the oxides that not much progress has been possible in this direction. Bhatnagar, King and co-workers (*J.C.S.*, 1939, 1433) have now successfully tackled this question by showing that by the application of Weiss's modification of the Curie Law, values are obtained for the magnetic moments of the oxides of chromium and manganese which are in accord with theory and enable magnetic measurements to be used for the evaluation of the correct formulæ of oxides. The occurrence of quadrivalent chromium as a hydrated dioxide, CrO_2, H_2O, first reported by Bhatnagar *et al* (*J.C.S.*, 1938, 1428) is now further confirmed. Samples of chromic oxide prepared by different methods have slightly varying susceptibility values. It is suggested that these differences are due to the presence of impurities and, in particular, to small amounts of chemisorbed gaseous elements. The magnetic susceptibility of the various stages of decomposition of chromium trioxide has also been measured, and it has been found that there is little change in the magnetic susceptibility with variation of composition in non-stoichiometric oxides.

M. A. G.

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Solubility of Lead Sulphate in Solutions of Sulphuric Acid Determined by Dithizone with a Photronic Cell.—Norman Craig and George W. Vinal (*National Bureau of Standards*, 1939, Research Paper, R.P. 1165) have determined the solubility of lead sulphate in sulphuric acid solutions of concentrations comparable with those used in lead storage battery. The determinations were made at two temperatures, namely, 25° and 0° C. The results obtained are given in detail.

The method consisted in the addition of diphenylthiocarbazone reagent to the solution containing lead and comparing the colour developed with that generated in a solution containing known quantities of lead. The equivalence point was detected by an arrangement of a photronic cell and colour filter.

The saturation equilibrium was arrived at from both sides, *viz.*, undersaturation as well as supersaturation. The average error of the determinations is reported to be 0·7 microgram.

K. R. K.

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Determination of the pH Value of Papers.—Herbert F. Launer (*National Bureau of Standards*, 1939, Research Paper, R.P. 1205) has suggested a simple and rapid procedure for determining the pH value of papers. The factors studied included cold and hot extraction, time, and preliminary reaction of the water used for extraction. Grinding the paper was found to be unnecessary, but in the case of thick "Kraft" papers the time of extraction had to be prolonged for 20 hours.

The procedure recommended by the author is briefly as follows: 1 g. of air-dry paper is macerated at room temperature with distilled water (pH 5·9–7·0) and allowed to stand 1 hour in the case of ordinary paper and for 20 hours for thick and dense paper. The pH of the unfiltered mixture is measured with a glass electrode. Duplicate determinations agree within 0·1 pH. The relationship between the pH values and the stabilities of the papers is also briefly discussed.

K. R. K.

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Leeches of the Dal Lake, Kashmir.—Unfortunately, the study of the group of animals comprising the leeches has not engaged the attention of Indian zoologists till now, and therefore, we welcome this interesting account of the Kashmir Hirudinea all the more. M. L. Bhatia (*Bull. Dept. Zoology, Punjab Univ.*, 2, 1939) records the occurrence of four genera of leeches from the Dal Lake. The genera Glossiphonia (= Clepsine), Theromyzon and Hemiclepsis belong to the family Glossiphonidæ while the

arhynchobdellid Erpobdella comes under Erpobdellidæ. A new species has been added under Theromyzon, *T. matthaii* which closely resembles the Siberian *T. garjœwi*. Thus, we have two species of Indian Theromyzon, *T. sexoculata* Moore and *T. matthaii* Bhatia. In the latter species the middle of the body shows three annuli; the intestine has four pairs of cæca and the crop eleven pairs.

* * *

How They Grow Cotton in Egypt—A Comparison and Contrast.—Dr. Frank Crowther, the well-known authority on cotton cultivation in Egypt, who made a prolonged tour of about nine months in India, visiting the main cotton areas and inspecting the experiment stations engaged in cotton experimental work in this country, has now published his impressions which are both valuable and interesting (*Agr. & Livestock in India*, Vol. IX, No. 4). The most important contrast is in the yield of cotton; thus while in Egypt, it is 464 lbs. of lint per acre, irrigated cotton in the Punjab, Sind and Madras yields only at the rate of 135, 218 and 250 lbs. of lint respectively. Cotton land in Egypt often pays a rental of Rs. 100 to Rs. 120 an acre, and this breath-taking sum, in addition to water rates and other taxes—a truly staggering contrast with rents and taxes here. Cotton in Egypt is grown on good clayey soils under irrigation; in India clay land of the usual black cotton type, is deemed unfit for growing cotton under irrigation. Cotton in Egypt is heavily manured with artificial manures, principally nitrogenous; very heavy dressings amounting to as much as 600 lbs. of manure (93 lbs. of nitrogen) per acre are said to be common in Upper Egypt. The high yields are the result mainly of this heavy manuring, for the Egyptian soil is not inherently very rich nor is the Nile silt which is often acclaimed as the creator of Egypt's fertility any richer than the soil itself and can obviously therefore have little effect in raising the soil nitrogen supply. The trend in India in recent years to look with disfavour on the use of artificial manures is inexplicable to the visitor who feels that there is not enough experimental evidence to support this attitude. Indeed if Egyptian experience is any guide the need is all for a large use of such manures even though they may not be supplemented by much farmyard manure, without any fear of soil deterioration. The desirability of utilising clay soils for irrigated cotton is commended, and some ameliorative methods for getting over the drawbacks feared, which have led to the prevalent opinion against these soils, are suggested; these are, what is called, "sand-sowing" to correct faulty germination, and a rotation with a long fallow. In view of the possibilities of a successful application of these methods it is essential that these methods should be carefully tested. We should have greatly appreciated the visitor's views on the main trouble with irrigated cottons and indeed with all the American cottons grown in India, *viz.*, the leaf reddening and shedding of bolls and leaves which affect this cotton whether it is irrigated or grown dry, and which, notwithstanding investigations so far, have not been prevented. So great is the ravage and so hopeless the situation that it has even given rise to the opinion that India is unfitted for American cotton and should grow only Asiatic cottons. Lack of drainage is suggested as one probable cause but the trouble is common even where there can be no possibility of poor drainage. We also fear that sufficient note has not been taken of the significance of varietal characteristics, especially such as are due to the differing root systems, in interpreting Egyptian results for application in India. As regards dry or rain-fed cotton, an extension of the practice of bunding the fields across the lower contours which is now common in some parts of the black cotton soil tracts is commended. The crop failures frequent in the Ceded Districts cotton tracts have puzzled the visitor who says that in the Sudan which has a much smaller rainfall such failures are unknown. Earlier maturing jowars are suggested for the tract as a food crop; some of the common jowars of the Sudan are said to be earlier maturing and are recommended for trial.

The need for putting down experimental plots on ryots' holdings and for the use on a larger scale of the method of combining several factors in one scheme in the experimental plots on the Experiment Stations themselves are other matters stressed. The somewhat strong views expressed in favour of the use of artificial manures in India against the present attitude of certain workers is in our opinion a distinct service to the cause of increased crop production in India.

A. K. Y.

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Borer Pests in Forests.—Details are given in a recent number of the *Indian Forest Records (New Series) on Entomology*, just brought out by the Forest Research Institute, Dehra Dun, of 15 new species of *Cerambycidæ*, a family of forest insects popularly known as long-horn beetles, occurring in India.

The larvæ of the *Cerambycidæ* are borers. Some species are found in living trees, some in dead wood and a few in herbaceous stems. The family includes many of the most harmful forest pests. A study of these insects is therefore of great importance to forestry.

The biology of over 300 species of *Cerambycidæ* attacking some 600 different kinds of trees has been studied at the Dehra Dun Institute.

* * *

Flying Fish.—To the many valuable exhibits which the *Zoological Survey of India* have placed in the Fish Gallery of the Indian Museum, Calcutta, an addition has lately been made in a pictorial exhibit illustrating the flight of fish in air. These aerial excursions of the Flying-fish are made possible by their greatly enlarged pectoral fins which sometimes extend as far back as the tail, and are undertaken primarily in self-defence. The flight in fish is quite unlike that of birds, inasmuch as there is no actual movement of the "wings" (pectoral fins), which are held rigid and act like the planes of a "glider".

When about to undertake a flight, the fish accelerates its speed, and rushes along near the surface of the water moving its tail rapidly from side to side. Then it takes a sudden leap out of the sea and is borne along through air

with the pectoral fins outstretched and practically motionless. The chief motive power is supplied by the tail in the initial stages of the flight.

Recent investigations reveal that the duration of flights in fish rarely exceeds 30 seconds and that the comparatively longer flights extend from 200 to 400 metres; the average speed under favourable conditions ranges from 10 to 20 metres a second. As a rule the flights are close to the surface of the sea, but not infrequently fish are carried to a height of 15 or 20 feet by currents of air.

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Money and Banking, 1938-39.—The two volumes recently issued by the League of Nations (Geneva, 1939, pp. 58, price 1/-) are a continuation of the memoranda on *Commercial Banks* issued in 1931, 1934 and 1935, and of *Money and Banking* issued yearly since 1935. They are publications of the *League of Nations* which, whatever its prestige in the political field, maintains the highest degree of thoroughness in economic intelligence service, and these two books will remain like their predecessors the repository of accurate, authoritative and impartial information for the economist, financier and politician of whatever nationality and school of thought. Without going into details of the course of events in banking houses and Chancellories of the Exchequer in the several countries of the world, it will probably suffice to know that, owing to the play of two sets of factors, 1938 was an eventful year in the field of foreign exchanges that witnessed serious disturbances in international exchange relationships. On one side, political developments led to precipitate transfers of capital funds from one currency into another while, again, fall in the prices of primary commodities imposed severe pressure upon the balance of payments of agricultural debtor countries. It is also of interest to learn that in the earlier part of 1938, it was the continued depreciation of the French franc that attracted much attention, whereas, in the second half of the year, it was the decline in the gold value of the pound sterling which constituted the outstanding development in international monetary relations.

K. B. MADHAVA.

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Imperial Dairy Institute, Bangalore.—The *Annual Report of the Imperial Dairy Expert* for the year ending June 1938 (Manager of Publications, Delhi, 1939. 53 Pages, 19 photographs and 3 diagrams) describes the advisory work of the Imperial Dairy Expert and the research, educational, dairy and dairy husbandry activities of the Imperial Dairy Institute, Bangalore, and the Wellington Milk Depot in the Nilgiris. What deserves strong comment is that a report covering a 12-month period should take another 16 months to produce. The report has been carefully prepared and is generously illustrated, which enhances its educational value.

The Imperial Dairy Expert answered 142 enquiries, of which 28 were minor questions regarding dairy literature; the gross cost of answering each major enquiry amounted to Rs. 340. Most of the enquiries dealt with dairy husbandry, management and technology.

Particulars of the progress made in building up the herds of Sindhi and Gir cows and Murrah buffaloes are given; a slight rise in average yield was shown. Live weight increases in cows during the gestation period, and the growth rates of calves upto two years of age were determined but no figures are reported. A large number of analyses of milk was done; it would have been of considerable value to have included a simple statistical analysis of the results, if only as a distribution table. The testing of a milking machine gave unsatisfactory results. Care of the pipelines and efficient cleaning of the machine parts with detergent solution, assembly and steaming, should produce good results.

The subjects described on page 10 *et seq.*, are not "Dairy Husbandry Investigations", but "Milk Handling and Milk Products". Fermentative changes in milk have been studied in preparing butter cultures, the making of Surati cheese and lactic casein. Some attention has been paid to the conditions in ghee-making which contribute to the properties used in judging ghee quality, *e.g.*, flavour and texture. The findings show that a considerable amount of extra work is needed to explain crystallisation behaviour during the cooling of ghee. The making of ghee direct from cream has been studied; it is to be feared that the yields from such a method may be unsatisfactory owing to the physical nature of cream. Care in the washing of lactic casein and its drying in the shade give a product of good quality. These caseins could profitably be qualified further by a chemical analysis giving figures for fat and ash content.

Other investigations on milk secretion, detergents and dairy plant are referred to. It would be profitable to readers of this report were they to be provided with a fuller description of the results of the items of research and not to have to refer to papers published at some future, and perhaps distant, date.

Five papers were published by the Department, some in collaboration with the Indian Institute of Science. Here, again, a summary or abstract of each paper would be of value.

The rest of the Report gives the working of the farms, laboratories and dairies from the educational and administrative standpoint. It is interesting to note that although the Institute at Bangalore spent Rs. 1·346 lakhs per annum, it received Rs. 0·744 lakhs in return for produce sold, while the Wellington Milk Depot made a profit of Rs. 450 on an annual expenditure of Rs. 43,000.

W. L. DAVIES.

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Mysore Geological Department.—The recent issue (Vol. 37) of the *Records of the Mysore Geological Department* contains as many as 10 papers, embodying the work done by the officers of the Department during the year 1937–38, in addition to the General Administrative Report for the year by the Director. Some of these papers are of purely scientific interest and are the result of detailed mineralogical and petrological investigations; others deal with the more

useful economic aspects bearing on the existing or possible mineral industries of the State. An interesting contribution is the "Report on the marks of weathering on the statue of Gomateswara at Sravanabelagola, Hassan Dt.," dealing with the possible methods of warding off the further effects of this weathering and thus help to "pass on to posterity this magnificent piece of monolithic sculpture through ages to come".

* * *

Spectrographic Analysis.—We have received from Messrs. Adam Hilger, Ltd., two publications: (1) "Spectrographic Analysis in Great Britain," edited by A. C. Candler, and (2) "Absorption Spectrophotometry and its Applications: Bibliography and Abstracts 1932 to 1938" by O. J. Walker. The former is a compilation of contributions from a variety of industrial and analytical Laboratories in Great Britain and indicates vividly how widely modern spectrographic methods are in use, although but few technical publications are to be seen in the literature. The articles cover a wide range of subjects from alloy steels and lead sheet to agriculture and archæology, and have been arranged roughly under four heads: (1) Metallurgy, (2) Glasses, Paints and Fabrics, (3) Soils and Plants, and (4) Art, Archæology and Crime. The study of the brochure brings out why the spectrograph has been preferred to alternative methods of analysis: in some cases, as in routine control it is the quickest, in others, small traces may be more reliably estimated, and yet in some others analysis can be done with the very small quantities alone available.

The second is a timely publication which brings up-to-date the bibliography on Absorption Spectrophotometry. This optical technic is of practical assistance in many kinds of problems including qualitative and quantitative analysis, detection and measurement of chemical and physical changes, determination of the structure of molecules and materials, and colour analysis and measurement. By rewording the titles where required, and by providing short abstracts, a good guide has been given to the contents of the papers. They are all classified into 3 parts, the first dealing with applications to analytical and industrial problems, the second with applications to biochemistry and physiology, and the third with papers containing quantitative spectrophotometric data. An additional part IV is formed of the author index.

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Brown Trout, *Salmo trutta fario* Linn., in Himalayan Streams.—A plea for a thorough biological investigation of the waters of the streams before introducing any exotic species is made in a paper which Dr. Gulam Mustafa Malik read at a meeting of the *Royal Asiatic Society of Bengal*, held on 4th December. The author drew attention to Mitchell's observations regarding the destruction of the Mountain Barbels of the genus *Oreinus* from the Kashmir trout-streams in relation to the growth of Brown Trout. Analysis of the gut contents of 131 specimens of *Oreinus* from Chitral, Kagan Sub-division of the Hazara District, and Afghanistan was reported. "Brown Trout, a carnivorous fish, flourishes well in association with *Oreinus*, as the latter keeps the streams clean of the vegetable growth and other deleterious matter and thereby encourages the growth of insect larvæ that inhabit rocks and stones and form the food of Brown Trout. Further, its fry provide food for the trout during the season when insects which form its normal diet are scarce."

In a second paper, the same author discussed the case of mortality of the Brown Trout in the Jabori and Shinu hatcheries of the Hazara District, N.W.F. Province. "In the case of Jabori hatchery the mortality can be traced to excessive growth of algæ and to the development of thyroid tumours or goitre. The death of trout in Shinu hatchery can be attributed to malstripping and malnutrition." The author described an interesting case of visceral abnormality. This study has led the author to conclude "that some of the deaths at least could be prevented by the employment of better trained staff for manipulation during stripping and by feeding the fish on a suitable diet."

* * *

The Health Organisation of the League of Nations.—Although due to the present crisis in Europe the meetings and other activities of the Health Organisation that had been planned for September and October had to be postponed, the regular and permanent work of the Section has proceeded unimpeded. The Epidemiological Intelligence Service and the Singapore Bureau have continued to collect and distribute the information in the usual manner. "The work of the International biological standardisation, the preparatory studies for the unification of the pharmacopœiæ, the enquiries into anti-rabic vaccination and radiotherapy of cancer of the *cervix uteri* and the investigations into nutrition which are now proceeding in the Far East under the auspices of the Health Organisation will continue unhampered", according to a report contained in the latest number of the *Chronicle of the Health Organisation.*

In September, Professor Edmond Sergent wrote to say that the Pasteur Institute of Algeria is continuing, as in the past, experiments on the use of synthetic anti-malarial drugs, its trial tests with controlled vaccination against typhus fever, its work on B.C.G. and the preparation, in association with Sir Rickard Christophers, of a text-book for the unification of malaria terminology. Many other assurances of continued support have been sent to the Health Section by various health administrations, experts and scientific institutes. The aim, in Professor Sergent's own words, is for "all men of goodwill to rally to the support of the Health Organisation in an effort to assert the pre-eminence of intellectual work as a means of promoting the welfare of all".

"In the course of his tour, the Director of the Health Section found that the European Balkan countries directly or indirectly concerned were, in principle, favourable to concerted action under the auspices of the Health Organisation. From many other parts of the World, the Section has received encouragement and offers for help, which will certainly prove valuable if circumstances should call for action. Measures have already been taken to help the Roumanian Health Administration to procure the extra

stores and equipment that are required for the prevention of typhus fever."

* * *

The Faraday Society recently held their 33rd Annual General Meeting at Cambridge. Scientists the world over are aware of the outstanding position in the Society's activities achieved by their "General Discussions" which have been organised in recent years at the rate of two per year. These "Discussions" were inaugurated during the tenure of the office of Secretary by the late Mr. F. S. Spiers. The annual lectures delivered in memory of Mr. Spiers by distinguished scientists will in future take the form of an Introductory Lecture at such General Discussions of the Society. The Society has about 850 members on the roll, and besides publishing its own *Transactions* in the usual twelve monthly parts, works in co-operation with the *American Chemical Society* in the production of the *Journal of Physical Chemistry*. The Society accepts for publication suitable papers submitted by authors who are not members, but authors who are members will receive free reprints of their papers.

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University of Mysore.—I. *Meeting of the Senate*: (*a*) A Special Meeting of the Senate was held on the 17th November 1939, for awarding the Diplomas of candidates successful at the First L.M.P. Examinations of 1939, the Vice-Chancellor presiding.

(b) The ordinary meeting of the Senate for the year was held on the 17th November 1939.

(i) Among the propositions that were passed, mention may be made of the following:—(1) Revised scale of fees for the M.B.B.S. course, consequent upon the institution of a Second Examination for the Final M.B.B.S. in June. (2) Course of Studies in Chemical Engineering. (3) Course of study and scheme of examination in French and in Latin for the Intermediate Examination. (4) Revised syllabus in modern Physics. (5) Detailed course of studies for the B.T. Degree examination. (6) Institution of Geography as an optional subject of study for the Intermediate and Degree courses.

(ii) The following recommendations were made to the University Council by the Senate at the above meeting:—(1) Appointment of suitable Muslim graduates as Assistant Professors and Professors in all the departments of the University. (2) Enhancement of the number of free-studentships awarded to Muslim students. (3) Introduction of 'Islamic Culture and Civilisation' as one of the optional subjects in the Arts colleges. (4) Grant of conveyance charges to such of the purdah observing lady students as have not been granted any scholarships. (5) Establishment of a 'University Institute of Industrial Research' under the auspices of the University.

II. *University Extension Lectures*: The following lectures were delivered:—(1) Mr. L. M. Schiff, M.A. (Oxon.), Cawnpore, on 'India and the Modern Cult of Nationalism' at Bangalore and on 'The Truth about the Race Myth' at Mysore. (2) Dr. C. N. Srinivasiengar, D.Sc., Professor of Mathematics, College of Engineering, Bangalore, on 'The Solar System' in Kannada, at Channapatna and Malavalli. (3) Mr. K. B. Madhava, M.A., F.R.A.S., A.I.A., Professor of Mathematical Economics and Statistics, Maharaja's College, Mysore, on 'Some Problems of Forthcoming Population Census' in Kannada, at Tumkur and Madhugiri. (4) Mr. L. Rama Rao, M.A., F.G.S., Professor of Geology, Central College, Bangalore, on 'The Mountains of India' in Kannada, at Mysore.

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Viscount Nuffield and Mr. John Davison Rockfeller have been elected **Fellows of the Royal Society** under the terms of the Statute which provides for the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal service to the Society".

Industrial Notes

Hot Spraying of Shellac.—There have been instances in industry when a small improvement in the technique of application of a slight deviation in processing, has led to a phenomenal increase in the employment of the product in industries. The process of hot spraying which has been developed by the London Shellac Research Bureau, is one which has such potentialities and should, therefore, be further developed, extended and perfected with all possible speed. The method which is described in their Bulletin No. 5, October 1939, consists in using pulverised shellac and causing the powder to fuse by passage through a flame. The fused particles are projected on to a surface to form a well-bonded coat. The Bulletin describes the various means tried for securing a steady supply of the pulverised material to the flame, as also the development of a simple apparatus for effectively carrying out the process. A study of the operating conditions has been made. Present and potential fields of application are indicated.

We wish to congratulate the authors on this important contribution to the Indian Lac Industry.

Recent Researches on Lac.—Increasing contacts with lac-consuming industries have enabled the *London Shellac Research Bureau* to understand their problems and help in their solution. Among the many commercial preparations connected with lac products in which the Bureau has been engaged, is the development in the use of lac oil varnishes, used for lacquering tin food containers.

Quick drying paints of high gloss and flexibility are also being developed. Experiments are in progress to produce a quick-drying plastic paint which can be applied to rubber surfaces by brush or spray.

Highly elastic materials are now being made by polymerising modified lacs. Such products have shown high electrical resistance. If other mechanical results are satisfactory large quantities would be used for insulating flexible cables.

Tin and Its Uses.—The third number of the International Tin Research and Development Council's new quarterly review, *Tin and Its Uses*, contains accounts of the Council's *Bureau*

of *Technical Information*, and of the free technical service offered to tin consumers. It is explained how these services may be utilised by firms who, under war conditions, are operating for the first time processes involving tin, and some examples are given of the difficulties encountered in the application of tin in various industries, and of the methods recommended to overcome them.

There is an account of a method of polishing soft metals by electrolysis for microscopical examination which has important advantages over mechanical polishing, and it is claimed that the method produces surfaces of very high reflectivity.

Another article states that tomato products may absorb copper from equipment of copper or brass and that to replace such equipment by stainless alloys would be extremely expensive, but copper and brass may be rendered safe for any food at small cost by applying a coating of tin, by either hot dipping or electro-tinning. The latter method produces thick, serviceable coatings, but the Council is able to give advice on either process.

Other subjects dealt with in this issue include the adoption of tinned pistons in the motor industry to avoid troubles during running-in, and tests on the nutritive values of canned foods and on the causes and control of hydrogen swells in canned fruits.

An interesting recent development in the use of tin-plates consists in applying a highly decorative surface of another metal, such as copper, nickel or chromium, to produce what are known as "pre-finished" sheets which can be formed into a great variety of useful articles without requiring expensive plating and polishing operations after fabrication.

Jute Research.—An extension of the *Technological Research Laboratories* at Tollygunge for experiments on weaving and spinning fine yarns from jute and yarns from jutes blended with other fibres, such as flax, is under consideration of the *Indian Central Jute Committee*.

It is estimated that at present about 80 per cent. of the jute produced is used for making hessians, sackings and similar heavy cloths. There are big potential world outlets for the fibre in the production of clothing materials, furnishing materials for curtains, carpets, upholstery, etc., and the finer types of canvas.

Although much has been done in Europe and America, further research is necessary into the problems involved in the production of the finer qualities of jute cloths. Some of the difficulties are well known. For example when jute yarns are bleached, as is normally necessary in making clothing materials, there is a great loss in strength, which is particularly noticeable when the yarn is wet. This makes for poor resistance to laundering. Blending with flax, or doubling the jute yarn with a flax or cotton yarn may overcome the difficulties, but other possibilities are open for investigation.

Breeding of new varieties of jute yielding the finest and most suitable type of fibre offers considerable promise. Conditions of growth and retting and their influence on the type of fibre obtained also require further investigation.

Announcements

Lucknow University.—Faculty of Sciences, Special Lectures. Session 1939–40:—

January 10 and 11: Dr. A. C. Chatterji, D.Sc., "Stability of Colloids". January 12, 13 and 14: Prof. N. N. Sen Gupta, M.A., Ph.D., P.R.S., "The vicissitudes of the mind; (i) The course of mental growth; (ii) The profiles of the mind; (iii) Disintegration and decay of the mental personality". January 16 and 17: Mr. Boshi Sen, B.Sc., "Vernalisation". January 24 and 25: Dr. R. S. Verma, D.Sc., "Whittaker functions and wave mechanics". January 29, 30 and 31: Dr. S. Hasan Zaheer, B.A., Ph.D., M.L.A., "Sterols and related compounds". February 2 and 3: Mr. Kali Prasad, M.A., LL.B., "Planes of intelligence: (i) Criteria and the technique; (ii) Data and their interpretation". February 5 and 6: Dr. Makund Behari Lal, D.Sc., "Helminthology: (i) Host-specificity as applied to Helminths; (ii) Recent additions to our knowledge of Avian Trematodes". February 8, 9, 10 and 11: Dr. A. N. Singh, D.Sc., 'Some modern theories of integration". February 15, 16 and 17: Prof. A. C. Banerji, I.E.S., "Galactic dynamics: (i) Formation of arms of a spiral nebula, (ii) Polytropic gaseous configurations; (iii) The origin of planets and satellites". February 19 and 20: Mr. S. B. L. Mathur, M.Sc., "Cosmic Rays and subatomic particles". February 25, 26 and 27: Dr. A. B. Misra, D.Sc., "Reproduction in Indian birds".

Training in Librarianship.—Class for training will be held at the Imperial Library, Calcutta. The session will commence on March 1 and last for about six months. Admission will be restricted to 20, but will be open to applicants from all over India, including Indian States, preference being given to those already working in libraries. The minimum qualification for admission is a university degree, but those working in libraries will be required to have passed at least the Intermediate Arts examination. *No application will be considered if received after January* 30, 1940.

Provision has been made for training in classification, cataloguing, book selection, reference work, library routine and organisation, bibliography and library hand-writing. Diplomas will be awarded on the results of an examination at the end of the course.

The fee for the entire course will be Rs. 75 payable in advance.

The International Institute of Agriculture announces that a publication entitled "A new study of World Production and Trade in Oils and Fats" in two volumes has been recently issued. The first volume deals with vegetable oils and fats; the second with butter, pig and beef fats, marine animal fats, the consumption of oils and fats in the chief importing countries on the world market, the utilization of oils and fats, and the movement of prices. (Price 25 lire for each volume.)

The two volumes appear as Nos. 4 and 5 of the series of publications on the "Principal Agricultural Products on the World Market",

Messrs. G. Bell & Sons announce that the Tercentenary Memorial Volume on James Gregory, containing his correspondence with John Collins and his hitherto unpublished mathematical manuscripts, together with addresses and essays communicated to the *Royal Society of Edinburgh*, has been recently published. The volume is edited by Prof. Herbert Westren Turnbull, F.R.S., and has been published for the *Royal Society of Edinburgh*. (Price 25*sh.* net.)

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We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, Nos. 4–5.
"Agricultural Gazette of New South Wales," Vol. 50, Pt. 11.
"The Philippine Agriculturist," Vol. 28, No. 6.
"Biochemical Journal," Vol. 33, No. 9.
"Journal of Chemical Physics," Vol. 7, Nos. 10–11.
"Journal of the Indian Chemical Society," Vol. 16, No. 9.
"Journal de chimie physique," Vol. 36, No. 6.
"Chemical Products," Vol. 2, No. 6.
"Comptes Rendus (Doklady)," Vol. 24, No. 5.
"Experiment Station Record," Vol. 81, No. 4.
"Indian Forester," Vol. 65, No. 12.
"Transactions of the Faraday Society," Vol. 35, Nos. 222–223.
"Review of Applied Mycology," Vol. 18, No. 10.
"Nature," Vol. 144, Nos. 3647–3653.
"American Museum of Natural History," Vol. 44, Nos. 3–4.
"Occasional Notes" (Royal Astronomical Society), No. 6 (October 1939).
"Canadian Journal of Research," Vol. 17, Nos. 9–10.
"Journal of the Royal Society of Arts," Vol. 87, Nos. 4533–38.
"Journal of Research," National Bureau of Standards, Vol. 22, Nos. 5–6 and Vol. 23, No. 1.
"Sky," Vol. 3, No. 12 and Vol. 4, No. 1.
"The Lingnan Science Journal," Vol. 18, No. 4.
"Science Progress," Vol. 34, No. 134.
"Indian Trade Journal," Vol. 135, Nos. 1742–46.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences

November 1939. SECTION A.—Sir C. V. Raman and V. S. Rajagopalan: *Haidinger's rings in soap bubbles.* Soap bubbles suitably maintained to have a perfectly uniform thickness exhibit by transmission or reflection interference figures consisting of concentric rings which are essentially of the same physical nature as the Haidinger rings due to a plane-parallel plate. H. J. Bhabha: *Classical theory of electrons.* B. D. Saksena: *The complete Raman spectrum of glycerine.* 21 Raman lines (some of them new) and an O-H band have been recorded: 12 of these are polarised and 3 depolarised. On dilution with water, the line 674 becomes more diffuse, and increases in frequency by 15 cm.$^{-1}$ at 25% dilution. T. Vijiyaraghavan: *On the irrationality of a certain decimal.* F. C. Auluck: *On Poncelot polygons.* J. A. Nabar, P. M. Barve, A. M. Patel and B. N. Desai: *Adsorption of naphthols in the presence of different electrolytes and peptising agents and at different temperatures.* The adsorption on cotton fibre has been measured, under various conditions to understand the mechanism of the process of dyeing. B. K. Singh and B. Bhaduri: *Studies on the dependence of optical rotatory power on chemical constitution—Part XVI. Bromo-, and Iodo-, Aryl derivatives of stereoisomeric methylene-camphors.* V. T. Chiplonkar: *Rectification in discharge tubes.* A quantitative study is made of the rectification as a function of the pressure in the discharge tube, disposition of the electrodes, etc. S. S. Pillai: *On the smallest prime of the form* km + 1. S. S. Pillai: *On the number of representations of a number as the sum of the square of a prime and a squarefree integer.* S. S. Pillai: *On numbers which are not multiples of any other in the set.* R. S. Krishnan: *Scattering of polarised light in colloids.* The depolarisation of light scattered in the transverse horizontal direction when the incident beam is inclined at an angle θ to the vertical, has been studied. The calculated relationship does not strictly hold for particles of any size and shape; the deviations are however not large and may be due to a second order effect. D. N. Moghe: *On the stability of equilibrium of an isolated fluid sphere.* D. N. Moghe: *On some non-static solutions of Einstein's gravitational equations, and fluid spheres with the pressure and density as slowly varying functions of time.* S. Siddiqui and V. Sharma: *Studies in the conessine series—Part V. Reduction of nitro-connessine to conessine-oxime and conversion of the oxime to mono-oxy-conessine.*

November 1939. SECTION B.—S. A. Akhtar: *On some nematode parasites from Afghanistan.*

Indian Association for the Cultivation of Science (*Proceedings*):

August 1939.—Debeshchandra Roy: *New measurements of aluminium monoxide bands.* M. V. Sivaramakrishnan: *A simple method of coating optical surfaces with aluminium.* S. A. Aziz: *Raman spectrum of diphenyl in the solid state.* J. N. Bhar: *Studies of the ionosphere at Calcutta.* Mohinimohan Ghosh: *Dynamics of the pianoforte string and the hammer—Part III (General Theory).* L. Sibaiya and M. Rama Rao: *Surface tension and Lindemann Frequency.* L. D. Mahajan: *Liquid drops.*

Indian Chemical Society:

September 1939.—SHARIFUDDIN WARSI AND SALIMUZZAMAN SIDDIQUI: *The constituents of* Didymocarpus Pedicellata—*Part III. Isolation of a sesquiterpene and two polyterpene products and examination of the fatty matter.* K. P. BASU AND M. C. MALAKAR: *Calorific values of Indian foodstuffs.* PANCHANAN NEOGI AND KANAI LAL MANDOL: *Co-ordinated copper compounds with propylenediamine.* N. L. VIDYARTHI AND C. J. DASA RAO: *Fatty acids and glycerides of the fat from the seeds of* Garcinia Indica (*kokum butter*). N. L. VIDYARTHI AND M. VENKATESH MALLYA: *Fatty acids and glycerides of the oil from Sapota seeds* (Achras Sapota). K. P. BASU AND K. GUPTA: *The role of vitamins and calcium in the diet in the utilisation of proteins.* PHULDEO SAHAY VARMA, N. B. PAREKH AND V. K. SUBRAMANIUM: *Halogenation—Part XXI. Direct replacement of aromatic sulphonic groups by chlorine and bromine atoms.* N. R. DHAR AND E. V. SESHACHARYULU: *New aspects of nitrogen fixation and conservation in the soil—Part III. Influence of light on bacterial numbers and nitrogen fixation.* PHULDEO SAHAY VARMA AND (MISS) K. M. YASHODA: *A note on the iodination of a few halogenated phenols.* N. L. VIDYARTHI AND M. VENKATESH MALLYA: *A note on the occurrence of an isomer of recinoleic acid in the fatty oil from the seeds of* Vernonia Anthelmenitica.

Indian Botanical Society:

September 1939.—SAYEEDUDDIN, M., AND MOINUDDIN, M.: *Anatomical study of* Holmskioldia sanguinea *Retz.* (*Verbenaceæ*). KRISHNA IYENGAR, C. V.: *Development of embryo-sac and endosperm-haustoria in some members of scrophularineæ—III.* Limnophila heterophylla *Benth, and* Stemodia viscosa, *Roxb.* FOTIDAR, A. N.: *The primary vascular system of the stem of* Nyctanthes arbortristis *L.* SULTAN AHMAD: *Higher fungi of the Punjab plains—I. The Gasteromycetеæ.* FOTIDAR, A. N.: *An example of a naked ovlue in* Galphimia gracilis. PARIJA, P. AND SAMANTARAI, E.: *March of transpiration of a leaf since its measurable stage to its fall.* SÂNÉ, Y. K.: *A contribution to the embryology of the Aponogetonaceæ.*

The Geological, Mining and Metallurgical Society of India:

The recent numbers (Vol. XI, Nos. 1 and 2) of the quarterly journal of the above Society contain several papers of geological and metallurgical interest. Of these the following may be mentioned: *Geology of the area around Phonda and parts of Bavda Jahgir (Ratnagiri Dt., Bombay)* by R. D. GODBOLE, and *Geology and petrology of the iron ore deposits of Mandi State, Punjab,* by S. K. ROY AND A.N. MUKHERJEE. A paper by D. SWARUP AND T. V. N. KIDAO records certain valuable observations on the "Heat treatment of high carbon stainless steels".

The Society has also recently published a Bulletin on "The uses and applications of sheet and waste mica" by the well-known mica specialist Ramani Ranjan Chowdhury, in which quite a lot of useful information has been condensed, which is sure to be of great value to those interested in the development of the mica industry in India.

Meteorological Office Colloquium, Poona:

October 12, 1939.—A. K. MALLIK: *Sorption with special reference to the exchange of moisture between the air layers near the ground and soil and plant materials.*

October 19, 1939.—DR. N. K. SUR: *A discussion of some sounding balloon ascents during a depression in July* 1937.

October 27.—C. RAMASWAMY: *Petterssen's paper on some aspects of formation and dissipation of fog.*

Errata

1. Vol. 8, No. 10, October 1939, page 470:—
Column 1, last line of the first paragraph: for "Kamai Lal Mandal" read "Kanai Lal Mandal".

2. Vol. 8, No. 11, November 1939, page 512:—
Note entitled "Condensation of Chalkones with Flavanones":

Column 1, line 4, *for* Ph·CO·CH = CO·Ph *read* Ph·CO·CH = CH·Ph.

Column 2, line 1, *for* "pulverisodium" *read* "pulverised sodium".

Column 2, line 2, *for* "the last two being" *read* "the last two reagents being".

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